BARNHART

A Study of some of the Factors that Influence the Yield and the Composition of Growing Pasture Grass

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A STUDY OF SOME OF THE FACTORS THAT INFLUENCE THE YIELD AND THE COMPOSITION OF GROWING PASTURE GRASS

BY

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B. S. University of Illinois, 1906

THESIS

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I HEREBY RECOMMEND THAT THE THESIS PREPARED UNDER MY SUPERVISION BY

Jesse Melangthon Barnhart

ENTITLED A Study of Some of the Factors that Influence the Yield and the Composition of Growing Pasture Grass.

BE ACCEPTED AS FULFILLING THIS PART OF THE REQUIREMENTS FOR THE DEGREE OF Master of Science in Chemistry.

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Committee on Final Examination

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INTRODUCTION

The pasture is the last part of the farm to receive any care. The general opinion among farmers seems to be that this part of the farm can take care of itself. Considering the immense amount of investigational work carried on to solve other agricultural problems it would seem that the agricultural experimentalist has taken almost the same view of the situation as the farmer himself. As this country becomes more thickly populated and the grass areas are broken up the increasing importance of pastures becomes more apparent. It has often been said that good grass is the basis of good agriculture. Certainly few will disagree with the statement that good grass is the basis of the animal industry, particularly the dairy part of this industry. With the business of dairying, growing of necessity as certainly as the density of population, it is apparent that investigations into the methods of increasing the efficiency of pastures are needed.

When the agricultural experiment stations were established in this country several investigators took up the study of grasses. (1) In 1888 and 1889 Armsby, Caldwell and Holter carried on investigations into the yield, composition and digistibility of pasture grass at the Pennsylvania Station. About the same time, (2) Hunt of the Illinois Station, published a bulletin on "Grasses and Clovers" that took up the study of the effect of ripeness upon the yield and composition. A year later (3) Wade of Iowa, published a study of the chemical composition of Blue Grass. Other (4) station workers have published numerous analyses of pasture grass, but it seems that no systematic study has been made in recent years upon the

yield, composition and nutritive value of pasture grass as influenced by the different factors that might be introduced to increase the efficiency of pastures. This problem was thought to be of sufficient importance to warrant an attack upon it, by this department, with the modern methods that were unavailable for use by the pioneer investigators.

Since this investigation was started a bulletin[5] has appeared from the Cornell Station on "Pastures in New York State." Simultaneously, from the[6] Pennsylvania Station another bulletin was published upon "Meadows and Pastures." In these two investigations grass mixtures and their efficiency as to yield received the most attention, with fertilizers receiving the remaining consideration. No attempt was made to study the composition of the grass.

PLAN OF EXPERIMENT

Description of Plots

A systematic plan was laid in 1910 for the study of pastures grass from different points of view. The yield, composition and nutritive value as influenced by tillage, manure and cutting were included in the plan of investigation. With this purpose in mind, a portion of pasture land, well sodded with blue grass mixed with some white clover, was selected at the north end of the South Dairy farm (figure 1.) as representative of good pasture conditions and suitable for the purposes of this investigation. A suitable fence was erected for the protection of the grass from animals or tresspassers and the enclosure laid off into seven plots. Each plot contained an area of 1/40 acre with the dimensions of one rod in width by four rods in length.

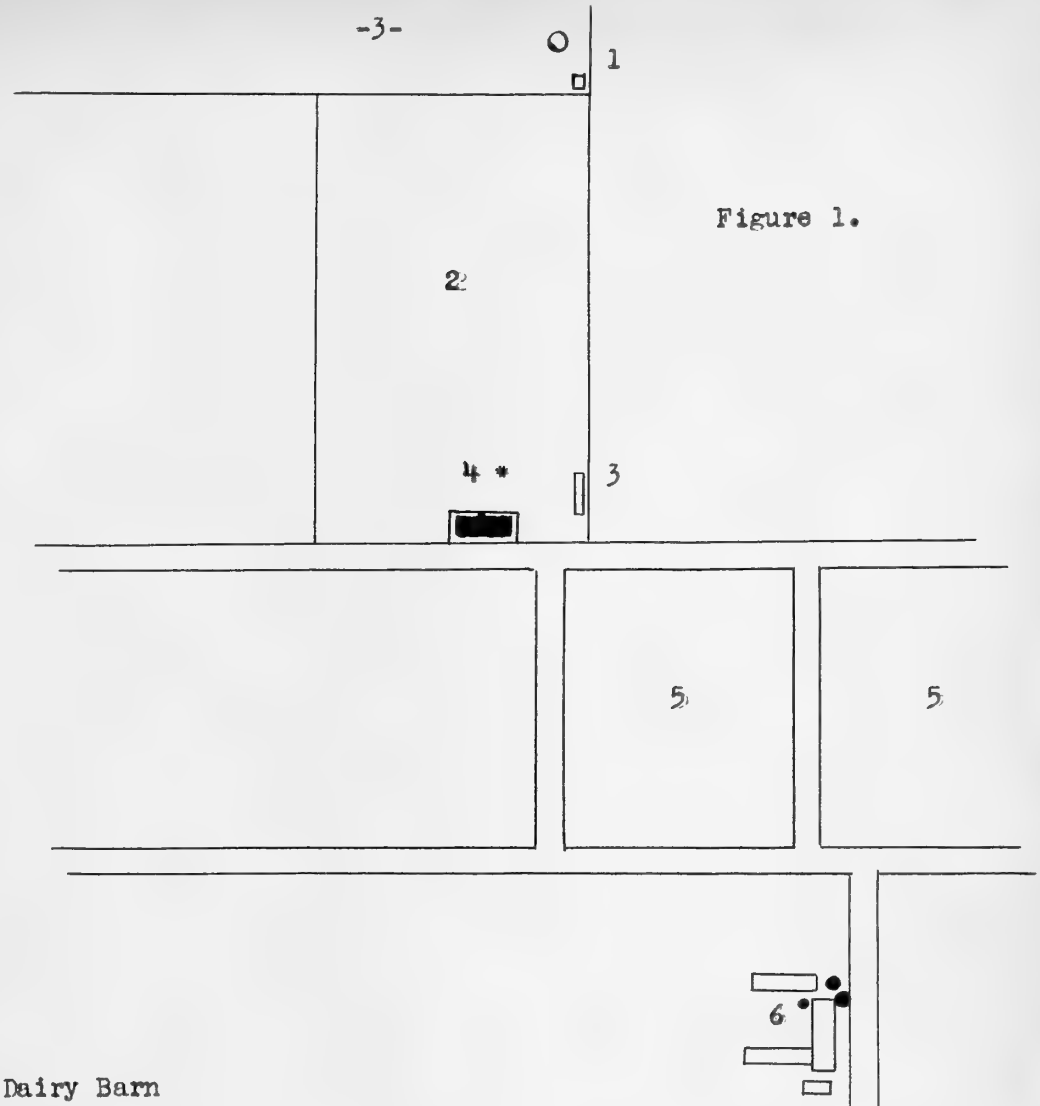


Figure 1.

1.- Round Dairy Barn

2.- Dairy Pasture Land (1910)

3.- Implement Shed

*4.- PASTURE EXPERIMENT PLOTS

5.- Cemetery

6.- North Dairy Barn

7.- Agricultural Building

Treatment of Plots

In the spring, as soon as the ground was dry enough to work, plots 3, 4, 5, and 6 (see Figure 2) were disced. In addition, plots 5 and 6 were treated with stable manure at the rate of 20 ~~pounds~~ tons per acre. Plots 1, 2, and 7 received no treatment.

Method of Cutting the Grass

Early in May, when the cows of the farm were turned out on grass, all of the plots with the exception of No. 7 were cut. The cutting was done with a sharp lawn mower which was run at the same adjustment, as to length, throughout the experiment. The machine was adjusted to cut as low as possible, the purpose being to cut as close to the ground as a cow could bite off the blades of grass. A lawn mower, thus adjusted was the closest imitation of a cow eating grass that we could get.

Plots 1, 3 and 5 were cut every week, while plots 2, 4 and 6 were cut every two weeks. The cutting of the grass was continued, with these intervals allowed for growth, throughout the pasture season.

Plot 7 was cut twice a year; the first time when ripe, about the the middle of June; the second time about the middle of September.

Method of Sampling Grass

The lawn mower was provided with a grass catcher or apron to collect the cut grass. As fast as the apron filled, the grass was emptied into metal cans. These cans were provided with tight fitting covers to prevent loss of moisture by evaporation. This precaution was necessary as the grass had to be carried a mile to the laboratory. Any evaporation became condensed in the upper part of the can and on the under sur-

Figure 2.

EXPERIMENTAL PASTURE PLOTS.

No. 6.	No. 5.	No. 4.	No. 3.	No. 7.	No. 2.	No. 1.
cut every 2 weeks - disced & manured	cut every week - disced & manured	cut every 2 weeks - disced	cut every week - disced	cut twice a year - no treatment	cut every 2 weeks - no treatment	cut every week - no treatment

face of the lid. This happened only in the hottest weather. In this event, the moisture was wiped out of the can with a portion of the cutting and then mixed, as thoroughly as possible, with the entire cutting. The grass was always cut in the afternoon to give ample time for the evaporation of any dew. In case of rain, the mowing was postponed until fair weather. These postponements, which were few, caused no sensible error in the results as fair and dry weather conditions followed within twenty-four hours.

At the laboratory, each cutting was accurately weighed to determine the yield of grass. A representative fraction, two to three pounds, was then taken from each as a sample. This sample was dried at room temperature.

Method of Drying the Grass

The drying was done in trays made especially for the purpose,of one quarter inch mesh wire netting. Each tray was three feet square and six inches deep, large enough to accommodate one sample in a thin layer. To prevent the grass from dropping through the mesh, the bottom of each tray was lined with thin muslin. The trays were arranged in a double decked rack carrying eight trays in all. At one end of the rack an electric fan was stationed to facilitate the drying process,by creating a constant change of air above the undried grass.

Preparation of Sample for Analysis

After drying, the samples were ground to a powder which was, in most cases, as fine as flour. A few samples, that were of particularly hard and tough growth, could not be ground quite this fine without danger of heating the burrs of the grinder. In this case it was thought better

to be content with a coarser sample than run the risk of introducig a greater error by heating the sample. A quantity of each ground sample sufficient to fill a Mason pint jar was kept for chemical analysis.

METHODS OF ANALYSES

The analysis consisted of moisture, protein, ether extract, ash, and carbohydrate determinations.

Determination of Moisture (7)

For the determination of moisture, from 1.5 to 2 grams of the substance were dried at 104 degrees C. in a current of dry hydrogen until constant in weight. The sample was weighed in a metal dish (a bottle cap of tin foil composition) about 2½ inches in diameter and one-half inch in depth. Each dish was provided with a cover for protection of the dry sample from any moisture in the atmosphere while on the balance pan.

Determination of Ether Extract (7)

The residue from the moisture determination was transferred to an ordinary glass extraction tube and extracted for 16 hours with anhydrous alcohol free ether in a Soxhlet fat extraction apparatus. The extract was dried at 100 degrees C. for intervals of one-half hour, until constant in weight. The anhydrous ether was prepared by dehydrating Kahlbaum ether with metallic sodium wire.

Determination of Ash (7)

For the determination of ash 2 to 2.5 grams of the sample were charred and burned until free of carbon, at the lowest possible heat and weighed.

(8)

Determination of Crude Protein

The crude protein was obtained by weighing about one gram of the substance into a 500 cc. digestion flask and treating with 25 cc. concentrated sulphuric acid and 0.65 grams metallic mercury. After heating until nearly colorless, the flask was cooled and 10 grams of powdered potassium sulphate added and digestion continued one-half hour when oxidation was complete. The solution of the oxidized material was diluted, treated with an excess of strong sodium hydroxide solution, distilled and titrated, to determine the nitrogen present as in the Kjeldahl method. The protein factor used was 6.25. Blanks were run on all reagents. Cochineal was used as an indicator.

Determination of Carbohydrates

The carbohydrates were determined by difference.

DISCUSSION OF DATA

Yield of Grass

In the study of the data collected in this investigation, the yield of grass naturally commands first attention. While the yield may have no relation to the nutritive value of the grass, it is evident that any increase in yield means an increase in the total supply of food nutrients. Data bearing upon this point is presented in Table 1. From this table and derived tabulations and curves, not only the variations in yield may be studied but the influences responsible for them.

Bearing in mind the different treatment of the plots and the fact that the soil, variety and stand of grass were as nearly alike, in all cases, as it was possible to select, the influence of the following factors upon the growth of pasture grass is present.

(a) The age of the pasture season.

(b) Tillage.

(b) Manure.

(d) Frequency of cutting grass.

In order to arrive at any conclusion as to the influence of these factors upon pasture grass, it was necessary to assemble or calculate the data from the experiment to a form convenient for study. Plot 1, the untreated plot cut weekly, is the check plot of the whole experiment. In the study of the effect of age of the pasture season, the results from this plot alone are used as this one corresponds nearest to the pasture under average farm conditions. The difference in the results from the check plot and the corresponding disced plot (Plot 3 cut weekly) is regarded as caused by discing.

The influence of the manure factor is obtained in the following manner: The results from Plot 5 (disced, manured and cut weekly) are subtracted from the results for the check plot. This gives the influence of tillage and manure combined. Having obtained the results of discing from Plots 3 and 1, this factor is deducted from the disced, manured influence. This data is considered as the influence of manure alone. The effect of frequency of cutting is obtained by a comparison of results from the check plot and its corresponding plots cut biweekly and twice per year, respectively. The influence of this factor upon tillage and manure is obtained by a comparison of each treated plot with its biweekly duplicate.

The Influence of the Age of the Pasture Season upon the Yield

A study of Table 1, check Plot 1, shows that the yields decrease after the first cutting until the first week in July, when they increase suddenly; a drop to yields corresponding to those of the first week in June then follows on the succeeding week.

Another increase is evident two weeks later. The yields then diminish and reach a minimum the second week of August. Still another increase is then noted and two weeks afterward,or the first week in September, the largest yields of the season are recorded. A sudden drop follows to yields corresponding to July production, succeeded by further decrease for the last week, - the second week in October.

A good growth in May and early June diminishing to August, with a return to May and June yields in the fall is characteristic of the growth of Blue Grass. The results here presented vary from the expected,in that the month of June is the poorest of the pasture season. The data in Table 2, which is a condensation of Table 1, brings out this point. A further inspection of the data in this table reveals monthly intermittent variations in yield, starting with May as the high point and alternating high and low yields per month throughout the season. This observation is presented graphically in Chart 1.

Influence of Tillage upon the Yield

The data upon this point is presented in Table 3. The results are expressed in weight increase and in increase in percent of undisced plot yields. From this table, it will be observed that the increase in yield due to tillage is small, outside the initial cutting, at the forepart of

the pasture season. A pronounced effect is first produced, beginning with the month of July. From this time on an increase of from 25 to 62 percent of the undisced plot yields is observed. Chart II. presents the data of Table 3 in a more comprehensible form. It will be noted that while the comparative increase; that is, the percent increase in yield is large, the actual weight increase is small.

The effect upon the total monthly yields is tabulated in Table 4 and plotted in Chart III. This chart presents the results in a still more comprehensible form than Chart II. From these data it is evident that tillage has a beneficial effect upon the growth of pasture grass. This effect is most pronounced during the latter part of the pasture season, particularly during the months of July and September.

The total annual increase expressed in weight increase is 29.5 pounds while in terms of percent of undisced plot yields, it is 29 percent. This is shown graphically in Chart IV.

The Influence of Manure upon the Yield

This data is presented in Tables 5 and 6 and Charts IV. and V. In Table 5, the weight increase and the increase in percent of unmanured plot yields for each cutting are presented. Chart V. is a graphic presentation of the data in Table 5. In Table 6, the data of Table 5 are condensed to show increase per month, likewise Chart V. is similarly condensed from Chart IV.

A study of these tables and charts reveals a large consistent increase due to the application of manure. Expressed in weight increase the results range from 56.6 to 60 pounds yield, as the maximum, the first cutting of the

season to 1.10 pounds as the minimum, - a cutting in mid-summer. Expressed in percent of unmanured plot yields, the results vary from a maximum of 532.8 percent, a cutting in October, to a minimum of 91.7 percent in August.

According to these data, with the exception of the opening and closing months, the effect of manure upon the yield is evenly distributed throughout the pasture season. An inspection of Chart V. brings out this point clearly. The months of May and October are the high points in the curve. The increase in percent of unmanured plot yields, for the month of May, is 242 percent. This is larger than the percent increase for any other month, except October. During this month the increase rises to 486.7 percent.

The total annual weight increase is 208 pounds, while the percent increase is 227.4 percent. This is shown in Chart VII.

The Influence of Frequency of Cutting upon the Yield

To study the influence of the length of the period between cuttings upon the yields of pasture grass, turn to Table 2.

An inspection of the data in this table shows that in every instance the plots cut once in two weeks produced more grass than those cut weekly. From these data it is apparent that the less frequent the cutting the larger the yields of grass. Plot 7, the plot cut twice a year, produced 169.60 pounds as against 91.50 pounds for check Plot 1, cut weekly, and 115.60 pounds for the check Plot 2, cut biweekly.

As to the relation of frequency of cutting to tillage, Table 4 shows that the percent increase in yield due to discing varies directly as the

Table 1 - Yields of Grass from Plots at each Cutting

Results in pounds

	No treatment			Disced		Disced and Manured	
	Plot 1	Plot 2	Plot 7	Plot 3	Plot 4	Plot 5	Plot 6
Date cut	Cut weekly	Cut biweekly	Cut twice a year	Cut weekly	Cut biweekly	Cut weekly	Cut biweekly
May 10	18.60	24.90		22.90	24.40	79.50	93.70
" 18	5.95			6.20		13.95	
" 25	5.20	12.80		5.80	10.90	13.45	27.20
June 1	4.60			4.90		12.60	
" 8	2.55	8.00	105.8	2.75	7.75	8.20	20.50
" 15	2.10			2.30		5.75	
" 22	1.80	5.75		1.80	5.05	5.45	13.00
" 29	1.60			2.00		5.25	
July 6	4.10	7.95		5.40	9.95	17.15	22.40
" 13	2.80			4.55		10.20	
" 20	3.60	9.05		4.90	12.05	12.05	24.15
" 27	3.20			4.60		8.90	
Aug. 3	2.50	6.90		3.50	9.30	6.70	15.20
" 10	1.20			1.85		2.95	
" 17	1.85	4.90		2.10	5.60	4.20	7.90
" 24	3.15			4.65		13.30	
" 31	3.90	10.10		4.80	13.40	14.45	30.50
Sept.8	9.80		64.00	14.45		25.90	
" 14	2.80	13.10		3.75	19.05	10.85	36.80
" 21	3.40			4.80		14.80	
" 28	2.65	7.70		3.50	8.50	13.80	32.60
Oct. 7	2.75			3.65		18.30	
" 13	1.40	4.45		1.85	5.20	7.40	23.80

frequency of cutting. This statement also holds true in the case of the manured plots. From Table 6, it appears that frequency of cutting is accompanied by the largest percent increase in benefits from the application of manure.

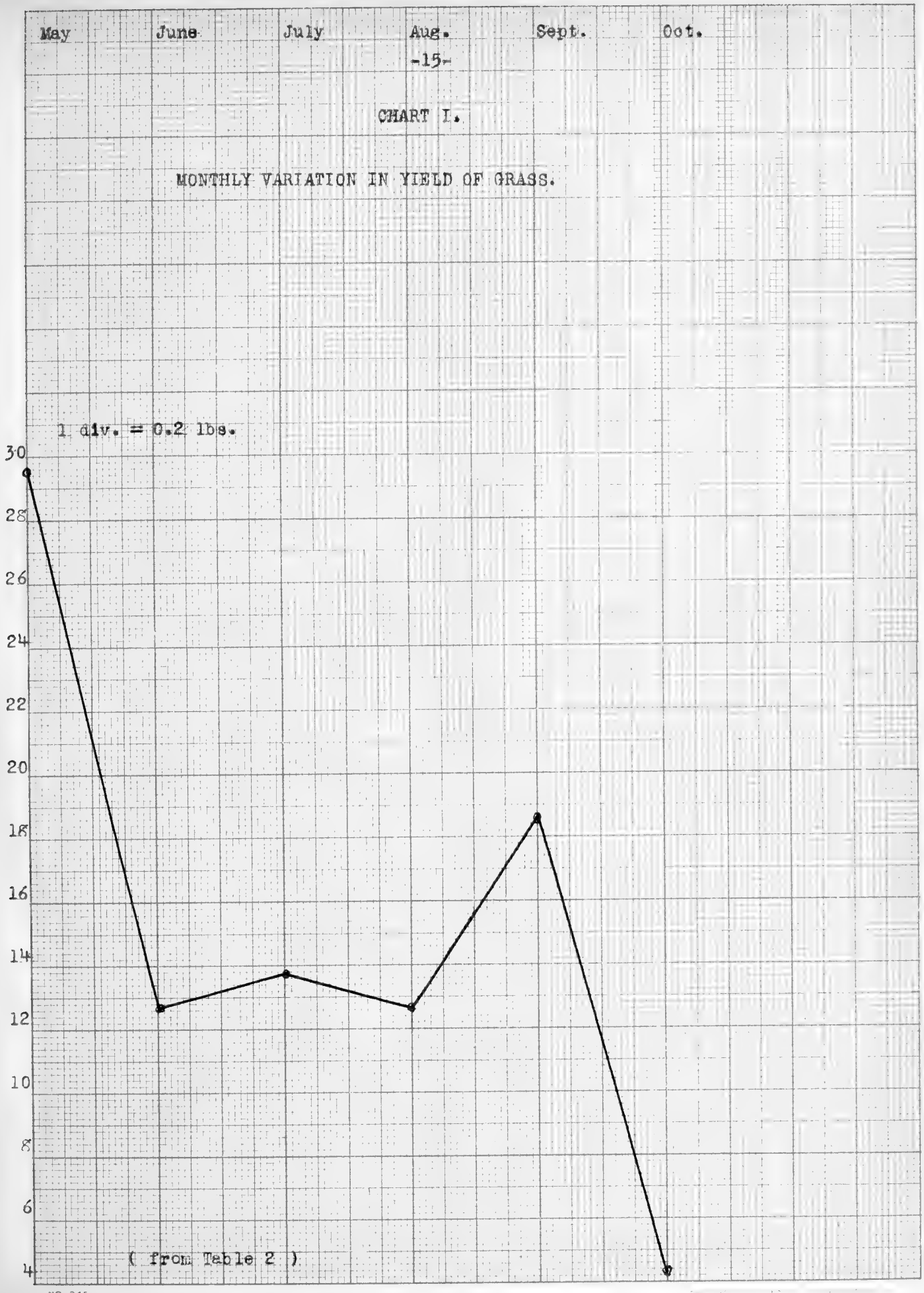
Table 2 - Average Yields of Grass for each Plot per month

Results in Pounds

	No treatment			Disced		Disced and manured	
Date cut	Plot 1 cut weekly	Plot 2 cut biweekly	Plot 7 cut twice a year	Plot 3 cut weekly	Plot 4 cut biweekly	Plot 5 cut weekly	Plot 6 cut bi-weekly
May	29.75	37.70		34.90	35.30	108.05	110.90
June	12.65	13.75	105.80	13.75	12.70	37.25	33.50
July	13.70	17.00		19.45	21.90	48.30	46.55
August	12.60	21.90		16.90	28.30	41.60	53.60
September	18.65	20.80	64.00	26.50	27.55	65.35	69.40
October	4.15	4.45		5.50	5.20	25.70	23.80
Total	91.50	115.60	169.80	117.00	131.05	325.10	337.75

CHART I.

MONTHLY VARIATION IN YIELD OF GRASS.



(from Table 2)

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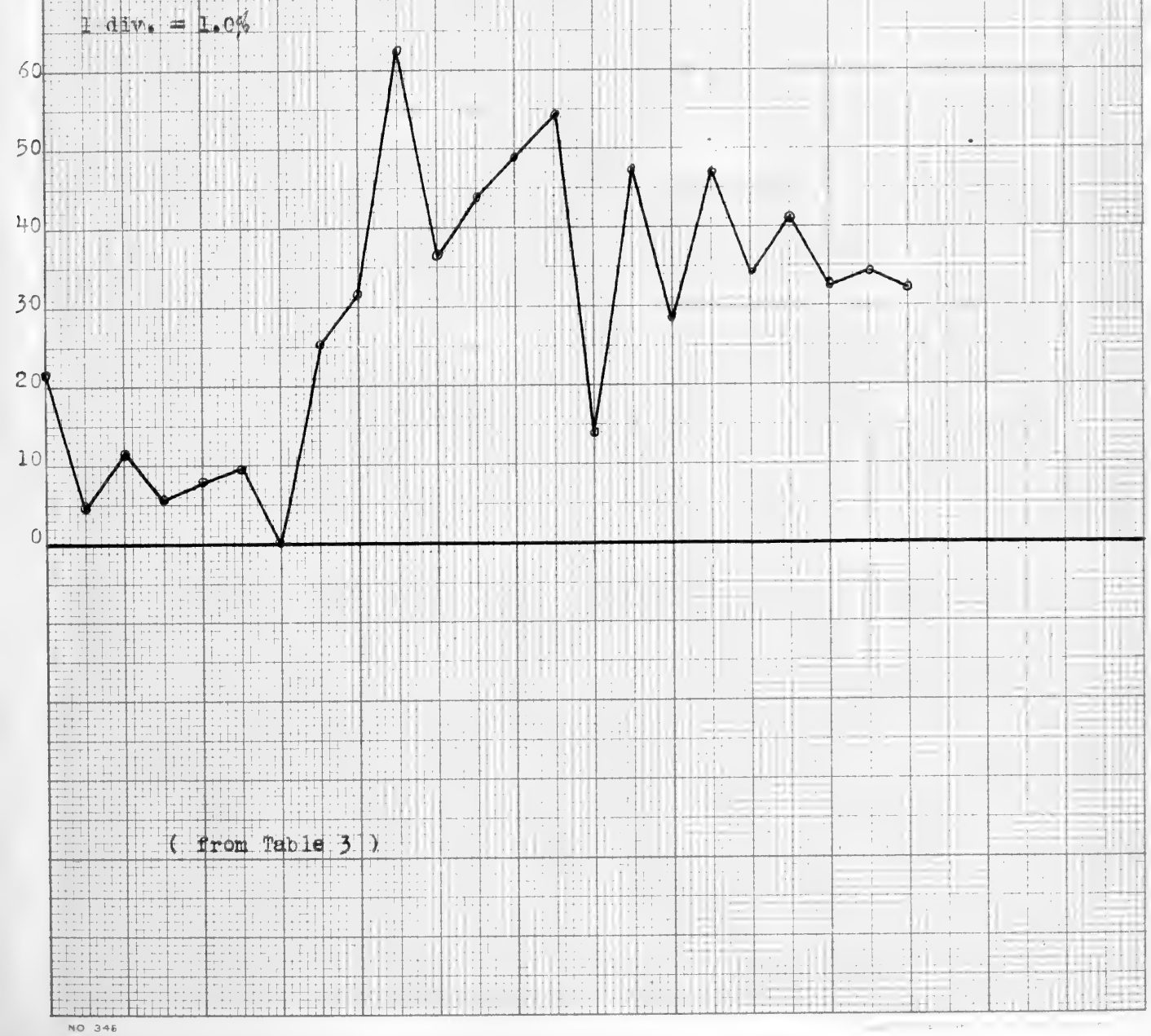
Table 3 - Influence of Tillage on Yield

Results for each Cutting

Date cut	Grass Cut weekly		Grass Cut biweekly	
	Increase in pounds	Increase in percent untreated plot yield	Increase in pounds	Increase in percent untreated plot yield
May 10	4.30	21.60	-0.50	-0.50
" 18	0.25	4.20	--	--
" 25	0.60	11.50	-1.90	-14.80
June 1	0.30	6.50	--	--
" 8	0.20	7.80	-0.25	- 3.10
" 15	0.20	9.50	--	--
" 22	None	None	-0.70	-12.20
" 29	0.40	25.00	--	--
July 6	1.30	31.70	2.00	25.20
" 13	1.75	62.50	--	--
" 20	1.30	36.10	3.00	33.10
" 27	1.40	43.80	--	--
Aug. 3	1.00	40.00	2.40	36.10
" 10	0.65	54.20	--	--
" 17	0.25	13.50	0.70	14.30
" 24	1.50	47.60	--	--
" 31	1.10	28.20	3.30	32.60
Sept. 8	4.65	47.40	--	--
" 14	0.95	34.00	5.90	45.00
" 21	1.40	41,20	--	--
" 28	0.85	32.10	0.80	10.40
Oct. 7	0.95	34.20	--	--
" 13	0.45	32.10	0.75	17.00

CHART II.

WEEKLY VARIATION IN THE INFLUENCE OF TILLAGE UPON THE YIELD OF GRASS.



(from Table 3)

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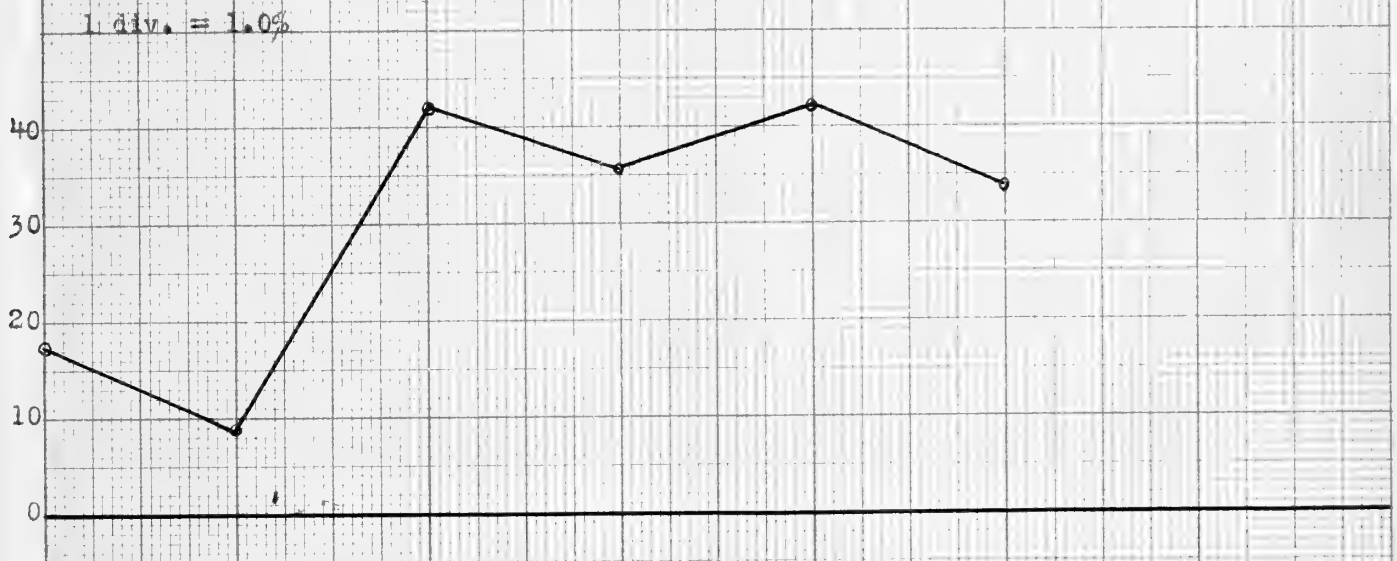
Table 4 - Influence of Tillage on Yield

Total Monthly Increase

	Grass Cut weekly		Grass Cut biweekly	
Month	Increase in pounds	Increase in percent untreated plot yield	Increase in pounds	Increase in percent untreated plot yield
May	5.15	17.30	-2.40	-6.40
June	1.10	8.70	-0.95	-6.90
July	5.75	42.00	5.00	29.40
August	4.50	35.70	6.40	29.20
September	7.85	42.10	6.70	32.20
October	1.40	33.80	0.75	16.80

CHART III.

MONTHLY VARIATION IN THE INFLUENCE OF TILLAGE UPON THE YIELD OF GRASS.



(from Table 4)

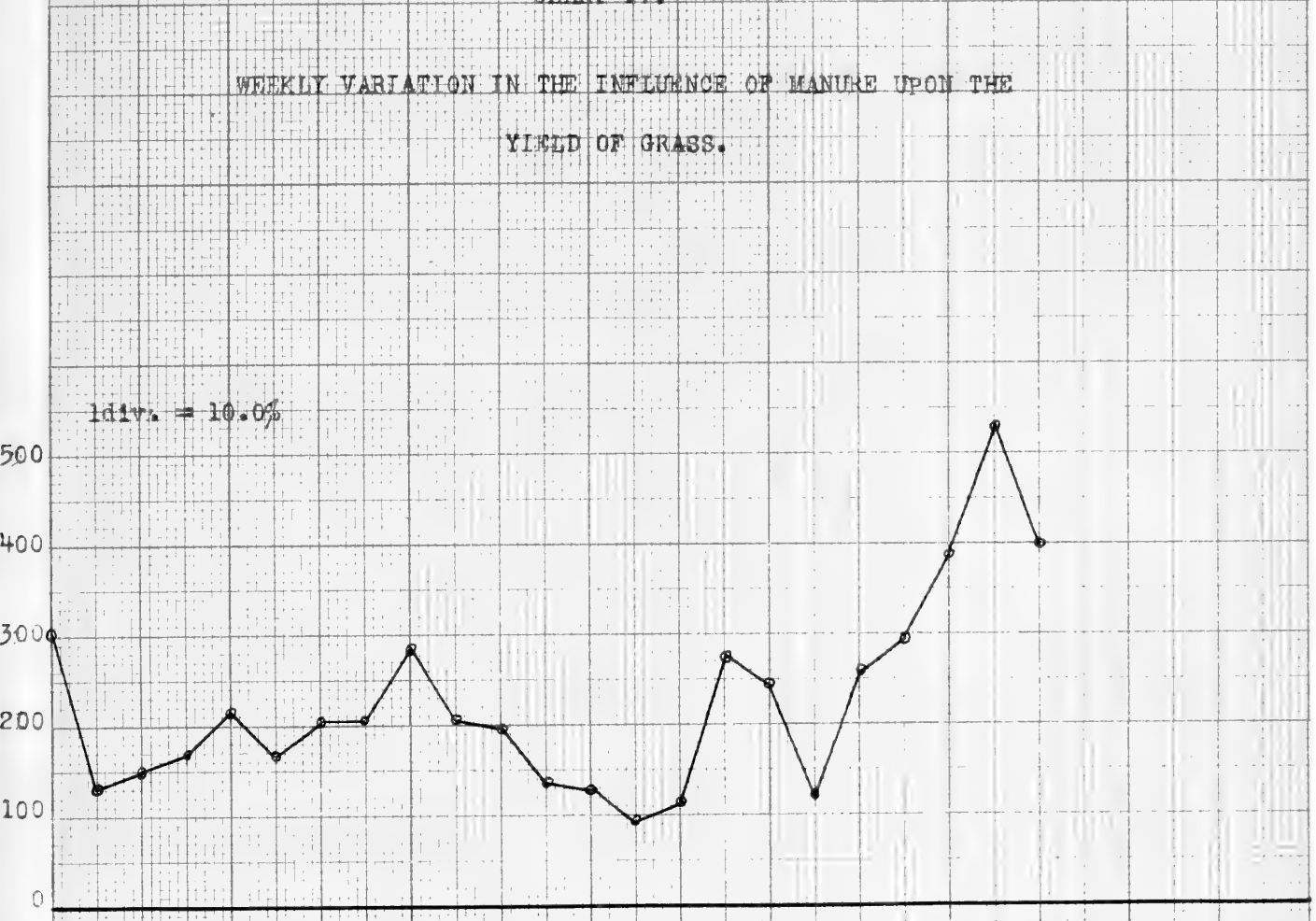
Table 5 - Influence of Manure on Yield

Results for each Cutting

Date cut	Grass Cut weekly		Grass Cut biweekly	
	Increase in pounds	Increase in percent untreated plot yields	Increase in pounds	Increase in percent untreated plot yields
May 10	56.60	304.30	68.80	236.10
" 18	7.75	130.20	--	--
" 25	7.65	147.10	14.40	112.50
June 1	7.70	167.40	--	--
" 8	5.45	213.80	12.50	156.20
" 15	3.45	164.30	--	--
" 22	3.65	202.80	7.25	126.10
" 29	3.25	203.10	--	--
July 6	11.75	286.60	11.45	145.30
" 13	5.65	201.80	--	--
" 20	7.15	198.60	12.10	133.60
" 27	4.30	134.40	--	--
Aug. 3	3.20	128.00	5.90	85.50
" 10	1.10	91.70	--	--
" 17	2.10	113.50	2.30	47.00
" 24	8.65	274.60	--	--
" 31	9.65	247.40	17.10	169.30
Sept. 8	11.45	116.30	--	--
" 14	7.10	253.60	17.75	135.50
" 21	10.00	294.40	--	--
" 28	10.30	238.70	14.10	183.10
Oct. 7	14.65	532.80	--	--
" 13	5.55	396.30	18.60	418.00

CHART IV.

WEEKLY VARIATION IN THE INFLUENCE OF MANURE UPON THE YIELD OF GRASS.



(from Table 5)

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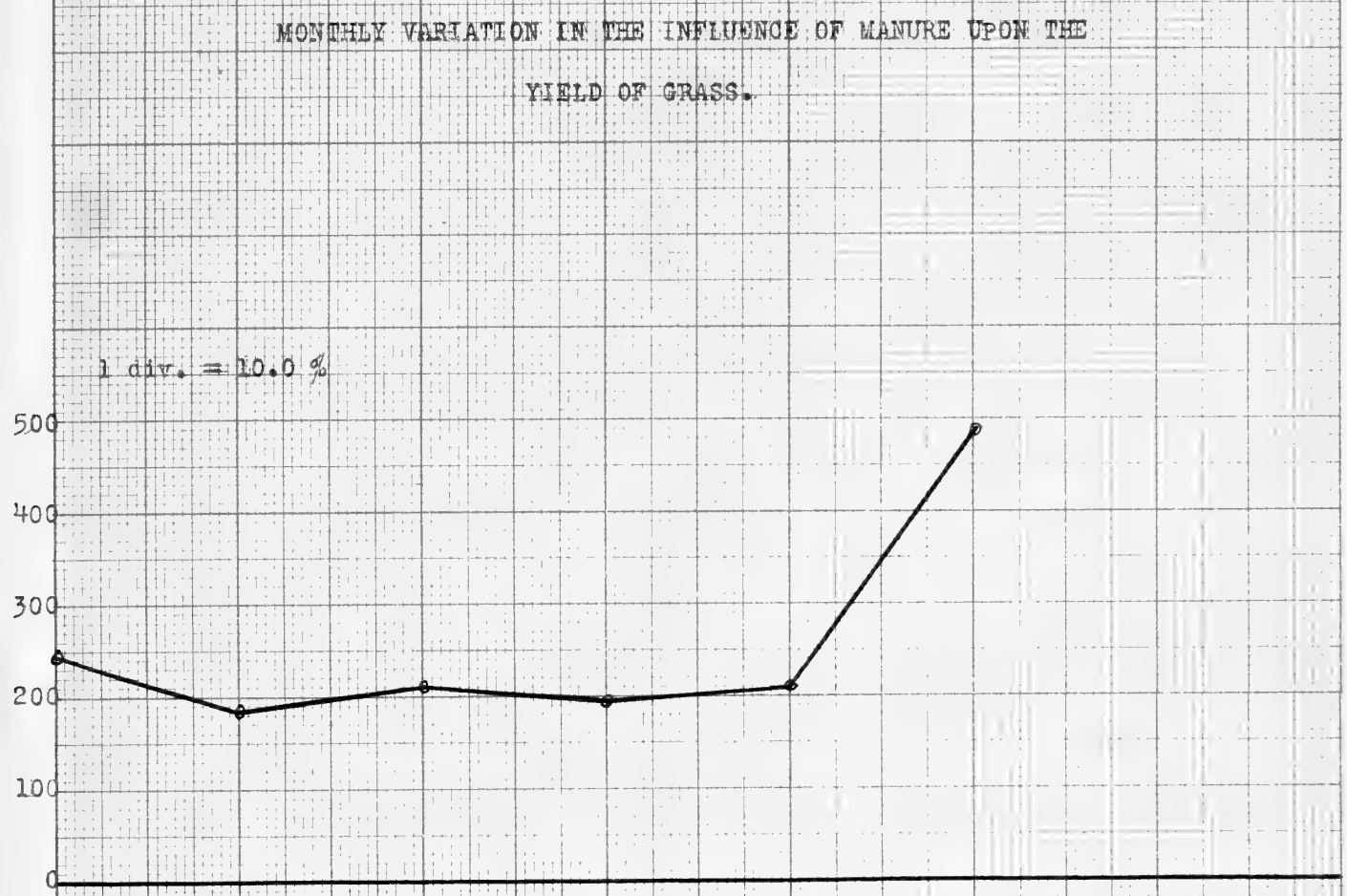
Table 6 - Influence of Manure on Yield

Total Monthly Increase

	Cut weekly		Cut biweekly	
Month	Increase in pounds	Increase in percent. Untreated plot yields	Increase in pounds	Increase in percent. untreated yields
May	72.00	242.00	73.20	194.20
June	23.50	185.80	19.75	143.60
July	28.85	210.60	23.55	138.50
August	24.70	196.00	25.30	115.50
September	38.85	208.30	31.85	153.10
October	20.20	486.70	18.60	418.00

CHART V.

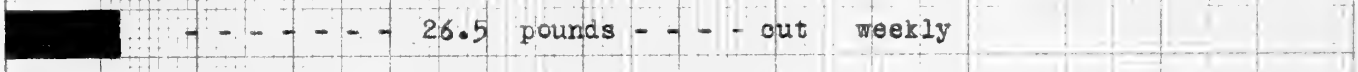
MONTHLY VARIATION IN THE INFLUENCE OF MANURE UPON THE YIELD OF GRASS.



(from Table 6)

CHART VI.

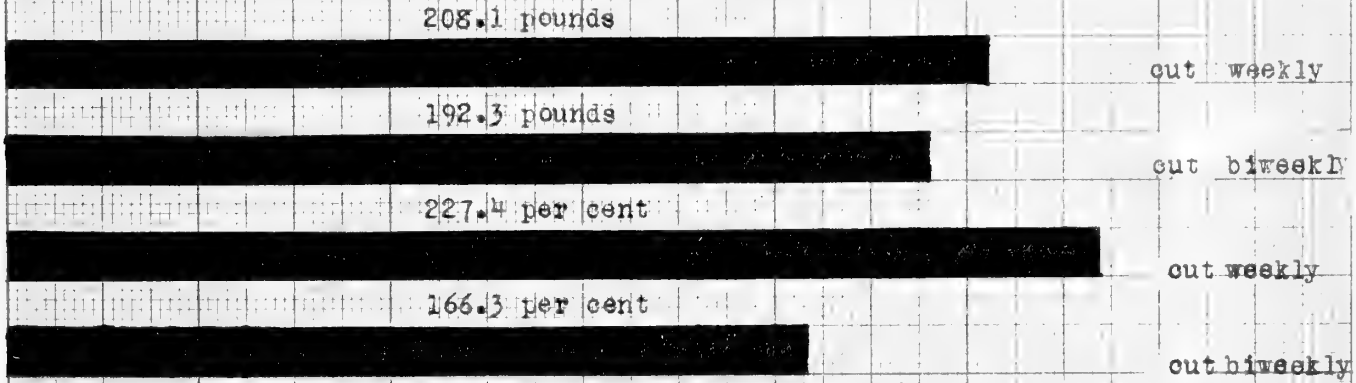
ANNUAL INCREASE IN YIELD DUE TO TILLAGE.



1 div. = 2.0% = 2.0lb.

CHART VII.

ANNUAL INCREASE IN YIELD DUE TO MANURE.



1div. = 2.0 % = 2.0 lb.

THE COMPOSITION OF THE GRASS

In the study of the composition of the grass each constituent is taken up separately and, as in the case of the yield, the following influences are studied:

(a) The age of the pasture season.

(b) Tillage.

(c) Manure.

(d) Frequency of cutting.

DRY MATTER

The dry matter is considered first. Table 7 contains data showing the percent of dry matter in the cuttings for each plot.

The Influence of the Age of Pasture Season

Taking up the influence of the age of the pasture season upon the variation in percent of dry matter, a study of the results for Plot 1, the check plot of the experiment, shows a reange from 23.96 to 45.78 percent. The variation in percent of this constituent is best shown by Chart VIII. in which the results are reduced to average percent of dry matter per month. The curve in the chart shows that the lowest percent of dry matter in pasture grass is in the month of May, while the highest is for June. The results range from 29.57 to 39.33 percent. After June the percent drops to 33.5 percent and remains practically constant for the remainder of the season.

Influence of Tillage

The influence of tillage upon the percent of dry matter in pasture

grass is shown in Table 10. The data appears in the first column. It will be seen that the average composition of grass grown on the disced plot shows an increase in dry matter for May, followed by a decrease for the remainder of the season up to the month of October. The maximum decrease of 4.65 percent occurs in July. The black line in Chart IX. is a graphic presentation of the results upon this point. From these data it appears that tillage causes a marked decrease in the percent of dry matter in the pasture grass. That is to say, grass growing upon soil that has been disced in the spring contains a higher percentage of moisture than grass growing upon undisced ground. Grass grown under the first conditions is a more succulent feed.

Influence of Manure

The influence of manure upon the percent of dry matter in pasture grass is shown in Table 10 and Chart IX. An inspection of the second column in the table shows an increase in percent of this constituent for the May grass, about equal to the effect produced by tillage. The remainder of the season the dry matter suffers a decrease. From a minimum in July of 0.49 percent, the amount steadily becomes greater, reaching a maximum of 6.92 percent at the end of the season. Chart IX. shows this point clearly. From these results, it appears that the manuring of pasture grass produces grass that is a more succulent feed than grass grown upon unmanured soil.

It will be noted from the chart that the succulent effect, if it may be called such, of manure is most apparent during the latter part of the pasture season, while the greatest benefit from tillage in this respect is earlier in the season.

Influence of Frequency of Cutting

The data upon the influence of frequency of cutting upon the percent of dry matter in pasture grass is found in Tables 11 and 12 and in Charts X. and XI. Chart XI. is a reduction of this data to its simplest and most comprehensible form. Curve 1. in this chart represents the fluctuations of percentage of dry matter in the grass cut biweekly, from the check plot, as compared with the corresponding plot cut weekly. The zone above the line represents increase, that below, decrease in percentage of dry matter. Curve 2 is a similar representation for tillage. Curve 3 is for manure. From a study of these data, it appears that although such infrequency of cutting as twice a year causes a large increase in percentage of dry matter of the grass, a lengthening of the period of growth, from one week to two weeks, has a tendency to decrease the percentage of this constituent for at least a definite part of the season. Grass cut biweekly during the months of July and August, shows a decrease in dry matter as compared with grass cut weekly for the same period. In July, particularly, decreases of over 4 percent are noted. According to the yearly averages, grass cut twice a year contains 44.97 percent of dry matter against 33.21 percent (a 11.76 percent increase) for grass cut weekly. The grass cut every two weeks has an average, for the year, of 32.81 percent, almost 0.5 percent less than grass cut weekly.

As to the effect of the co-relation of frequency of cutting and tillage upon the percentage of dry matter, it appears that in spite of some fluctuations of the curve between the plus and minus zones, the predominating influence is toward a decrease in percentage of dry matter. This is particularly evident the latter part of the pasture season. For the year,

the grass cut biweekly shows a decrease of 1.30 percent when compared with that cut weekly.

In the case of manure, the opposite effect is produced. Although some cuttings show a decrease in percent of dry matter, the co-related influence of cutting grass biweekly and manuring is to increase this constituent. The averages for the year show an increase of 1.53 percent of dry matter in biweekly cut grass over that cut weekly.

Table 7 - Variation in Dry Matter for each Plot at each Cutting

Results in percent

	No treatment			Disced		Disced and manured	
Date Cut	Plot 1 Cut weekly	Plot 2 Cut bi-weekly	Plot 7 Cut twice a year	Plot 3 Cut weekly	Plot 4 Cut bi-weekly	Plot 5 Cut weekly	Plot 6 Cut bi-weekly
May 10	28.27	28.44		33.05	27.60	29.37	30.03
" 18	29.96	--		32.44	--	36.32	--
" 25	30.49	31.04		31.49	31.37	30.23	29.32
June 1	31.51	--		31.36	--	30.10	--
" 8	34.31	34.54	46.64	34.29	34.92	30.65	29.39
" 15	35.76	--		32.78	--	29.45	--
" 22	45.78	45.26		46.15	39.74	43.58	40.84
" 29	39.97	--		32.62	--	31.63	--
July 6	33.08	32.26		29.91	27.99	26.72	41.65
" 13	32.98	--		27.90	--	25.67	--
" 20	32.47	28.60		30.98	32.32	30.21	27.71
" 27	35.67	--		26.82	--	31.04	--
Aug. 3	34.74	33.17		30.74	32.12	29.52	32.98
" 10	41.90	--		32.84	--	36.21	--
" 17	33.98	35.60		35.29	32.01	35.48	32.03
" 24	30.54	--		26.88	--	24.84	--
" 31	26.06	28.78		27.94	15.19	20.68	12.87
Sept.8	23.96	--	43.30	22.85	--	21.93	--
" 14	30.47	30.14		32.63	28.44	27.65	25.12
" 21	34.22	--		33.40	--	25.34	--
" 28	31.46	35.30		33.06	33.11	23.75	26.68
Oct. 7	35.60	--		35.01	--	26.66	--
" 13	33.20	31.78		35.47	33.59	26.62	25.21

Table 9 - Monthly Variation in Dry Matter

Percent results

Grass cut weekly			
Month	Plot 1 No treatment	Plot 3 Disced	Plot 5 Disced and manured
May	29.57	32.33	31.97
June	39.33	35.44	33.08
July	33.55	28.90	28.41
August	33.25	30.75	29.35
September	32.55	30.49	24.67
October	34.40	35.24	26.64

CHART VIII.

MONTHLY VARIATION OF DRY MATTER.

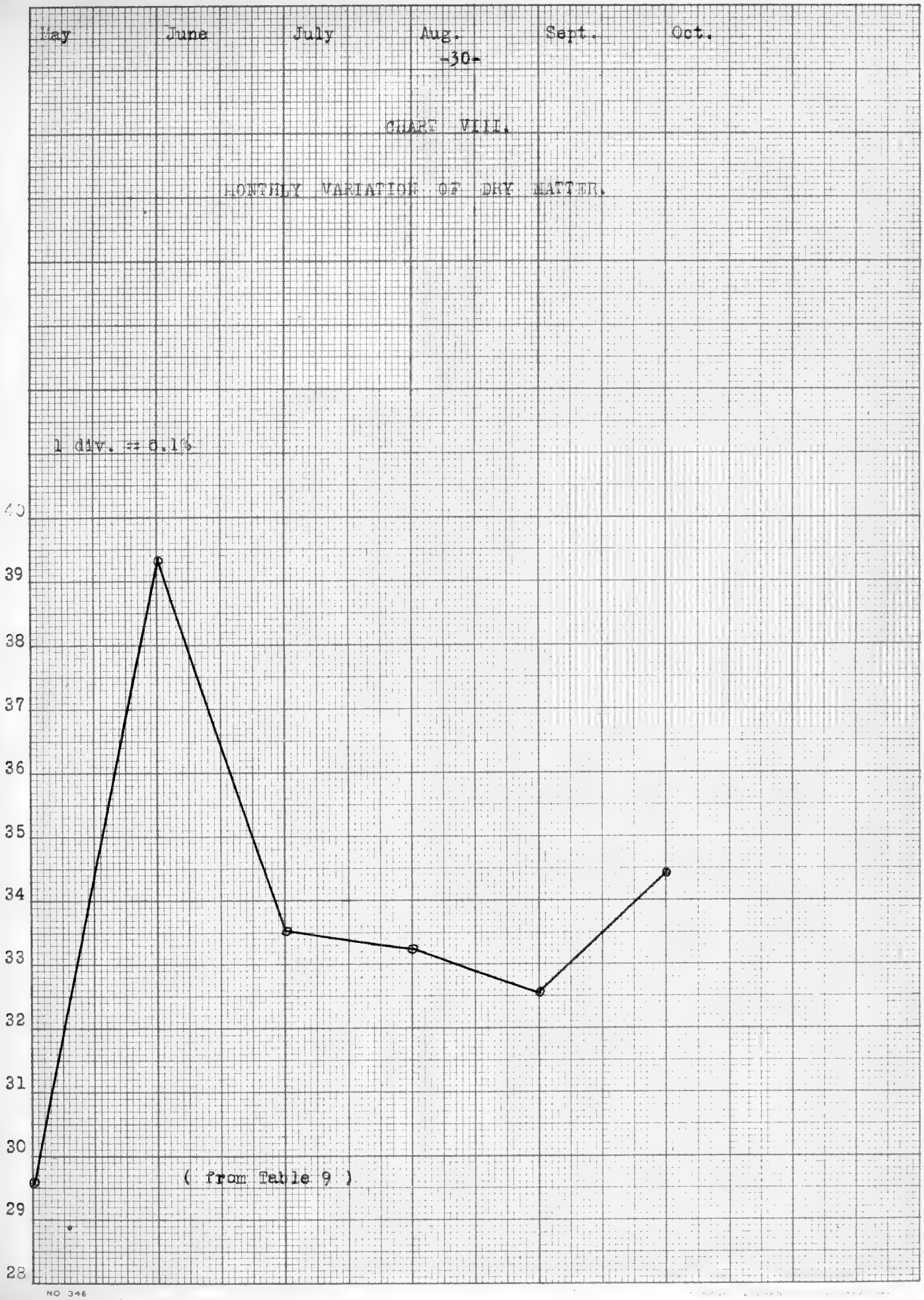


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Table 10 - Showing in the first column the monthly variation of the influence of tillage upon the dry matter of pasture grass, and in the second column the same data for manure

Results in percent

Month	Increase due to tillage	Increase due to manure
May	+2.76	+2.40
June	-3.89	-2.36
July	-4.65	-0.49
August	-2.50	-1.40
September	-2.06	-5.82
October	+0.84	-6.92

CHART IV.

INFLUENCE OF TILLAGE AND MANURE UPON DRY MATTER IN PASTURE GRASS

Curve I = decrease in dry matter due to tillage

Curve II= decrease in dry matter due to manure

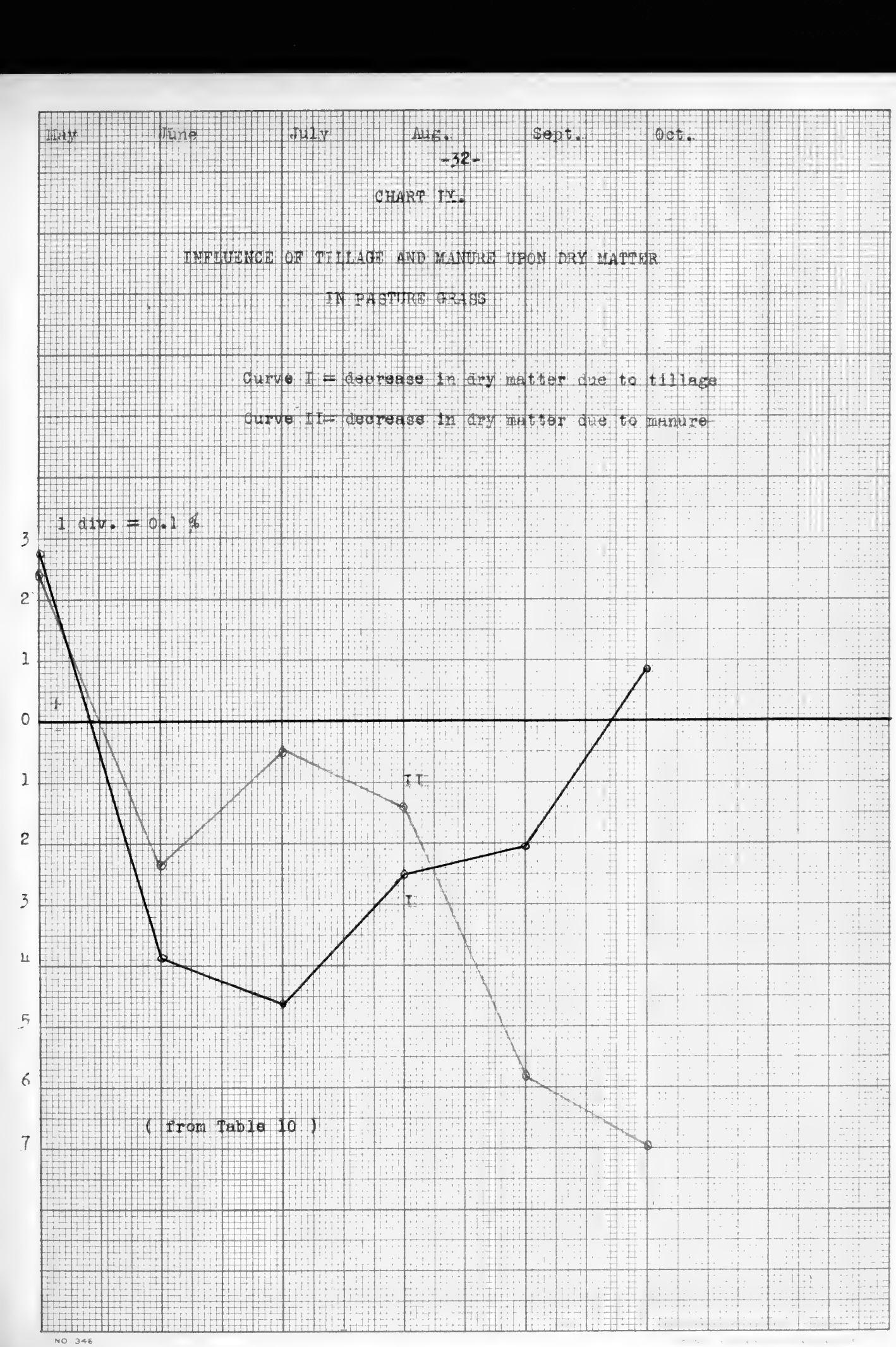

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Table 11 - Variation in Dry Matter. Weekly cut Plots Averaged to Compare with Biweekly cut Plots

Results in percent

Date cut	No treatment			Disced		Disced and manured	
	Plot 1 Cut Weekly	Plot 2 Cut biweekly	Plot 7 Cut twice a year	Plot 3 Cut weekly	Plot 4 Cut biweekly	Plot 5 Cut weekly	Plot 6 Cut bi-weekly
May 10	28.27	28.44		33.05	27.60	29.37	30.03
" 25	30.23	31.04		31.97	31.37	33.28	29.32
June 8	32.91	34.54	46.64	33.33	34.92	30.38	29.39
" 22	40.77	45.26		39.47	39.74	36.52	40.84
July 6	36.53	32.26		31.27	27.99	29.18	41.65
" 20	32.73	28.60		29.44	32.32	27.94	27.71
Aug. 3	35.21	33.17		28.78	32.12	30.28	32.98
" 17	37.94	35.60		34.07	32.01	36.35	32.03
" 31	28.30	28.78		27.41	15.19	22.76	12.87
Sept.14	27.22	30.14	43.30	27.74	28.44	23.79	25.12
" 28	32.84	35.30		33.23	33.11	24.10	26.68
Oct. 13	34.40	31.78		35.24	33.59	26.64	25.21

Table 12 - Variation of Dry Matter. A Comparison of Plots cut Biweekly with Plots Cut Weekly

Results in percent

Date	Difference between untreated plots	Difference between disced plots	Difference between disced and manured plots
May 10	+ 0.17	- 5.45	+ 0.66
" 25	+ 0.81	- 0.60	- 2.96
June 8	+ 1.63	+ 1.59	- 0.99
" 22	+ 4.49	+ 0.27	+ 4.32
July 6	- 4.37	- 3.28	+ 2.47
" 20	- 4.13	+ 2.88	+ 0.23
Aug. 3	- 2.04	+ 3.34	+ 2.70
" 17	- 2.34	- 2.06	- 4.30
" 31	+ 0.48	- 2.22	- 9.89
Sept.14	+ 2.92	+ 0.70	+ 1.33
" 28	+ 2.46	- 0.12	+ 2.58
Oct. 13	+ 2.62	- 1.65	- 1.43

May 10 25 | June 8 22 | July 6 20 | Aug. 3 17 31 | Sept. 14 28 | Oct. 13

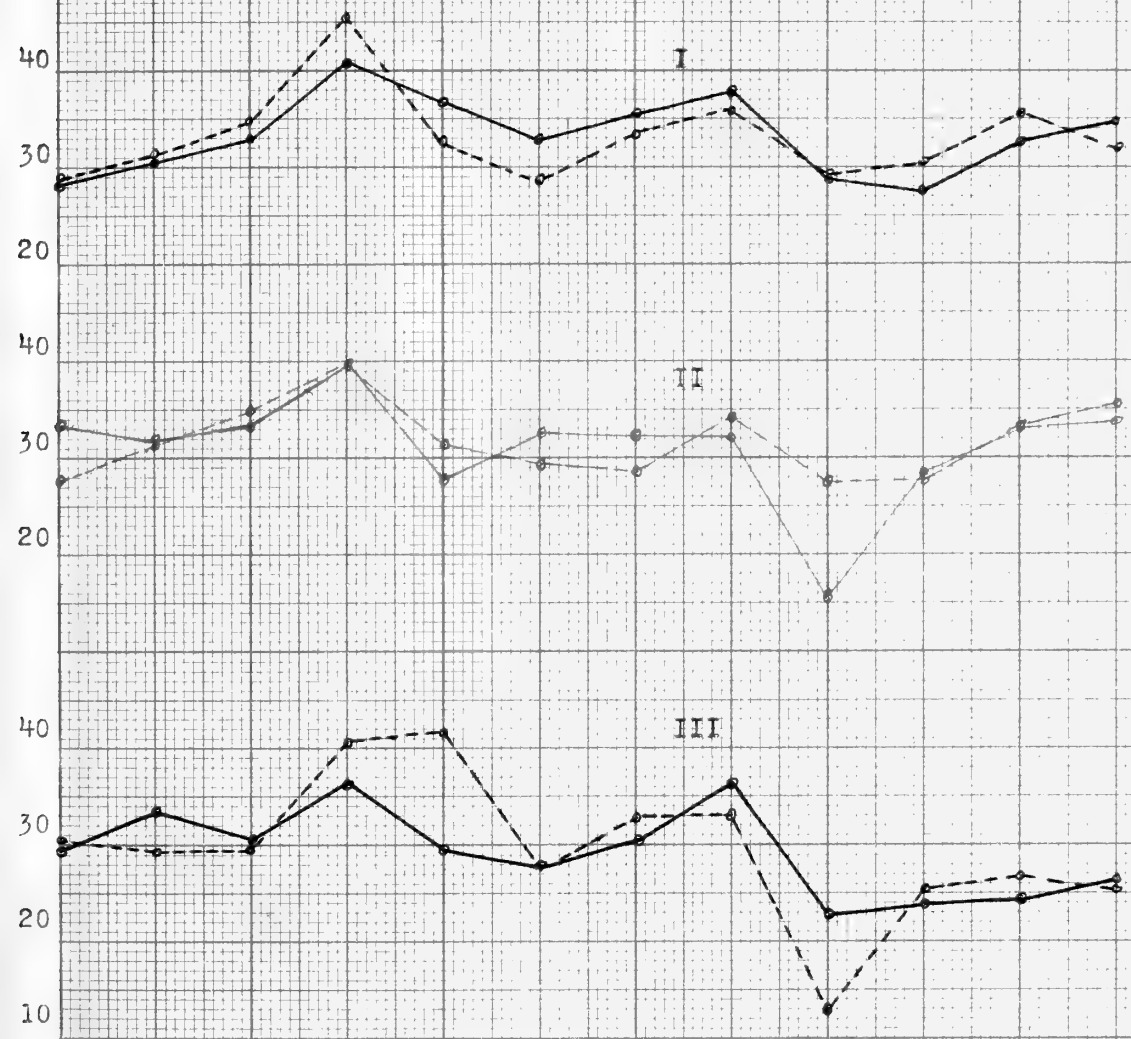
CHART X.

INFLUENCE OF FREQUENCY OF CUTTING UPON THE DRY MATTER OF PASTURE GRASS

I = Untreated Plots
II = Disced Plots
III = Disced, Manured Plots

——— Weekly cut plots
- - - - Biweekly cut plots

1 div.= 1.0 %



(from Table 11)

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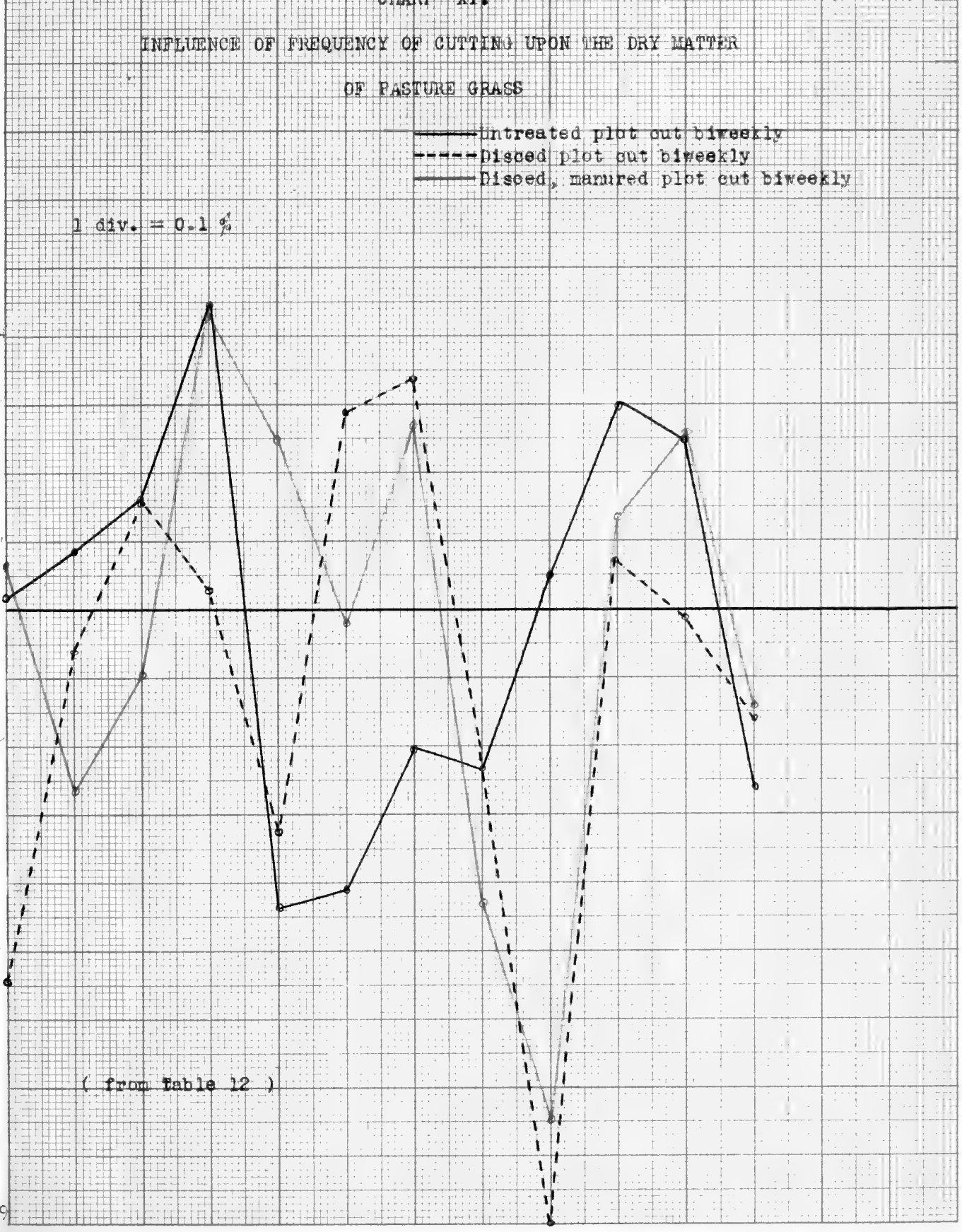
May 10 25 | June 8 22 | July 6 20 | Aug. 3 17 31 | Sept. 14 28 | Oct. 13

CHART XI.

INFLUENCE OF FREQUENCY OF CUTTING UPON THE DRY MATTER OF PASTURE GRASS

——— Untreated plot cut biweekly
- - - - - Disced plot cut biweekly
——— Disced, manured plot cut biweekly

1 div. = 0.1 %



(from Table 12)

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PROTEIN

In the remainder of the study of the composition of the grass the results are presented in two forms. They are calculated upon the fresh fresh basis and the water free basis. On the fresh basis, the amount of a given constituent is calculated in percent of the fresh grass as a basis. In the case of the water free basis, the calculation is made in percent of dry matter present. The use of the fresh basis, in this instance, facilitates the study of a constituent of the grass as it grows and is eaten by the animal, while the use of the water free basis affords a better means of comparison of the same constituent from different samples of grass.

Influence of Age of Pasture Season

The data upon the influence of the age of the pasture season upon the protein content of pasture grass is given in Tables 13, 14, 15, and 16, and Charts XII. and VIII. Calculated upon the fresh basis and expressed in average percentage composition per month, the percent of protein varies from 4.43 to 7.74 percent, a difference of 3.31 percent between the extremes. As shown by Chart XII. the protein content increases from 4.43 percent for the beginning of the season, to 6.21 percent for July. A decline then follows and the percent drops to 5.42 percent in September. The October results show an increase to 7.74 percent, the maximum of the season. Chart VIII. the corresponding curve for the water free basis data, shows a similar behavior.

From these results, it appears that the early grass has the minimum protein until by the middle of the season an increase of 2 percent has developed. A decline then follows of about one percent. The very late growth,

the October grass, contains a high protein content exceeding the May grass by over three percent, even richer in this constituent than the July grass by over one percent.

Influence of Tillage

In Tables 17 and 18 and Charts XIV. and XV. will be found the data upon the influence of tillage upon the protein content of pasture grass. The first column in the tables show the gain or loss in percent of protein caused by discing. The first curve in the charts is the graphic presentation of this data. Considering the results upon the basis of the fresh grass tillage has a beneficial effect upon the protein content at the beginning and end of the pasture season. It is in the middle of the season that a decrease in protein is noted. It must not be overlooked, however, that the gain in one part of the season is offset by an almost equal loss in another part of the season. The gain in protein per month ranges from 0.22 to 0.96 percent, while the losses vary from .02 to .91 percent. While the minimum gains or losses are insignificant and may be due to the probable error in analytical methods and manipulations, the maximum gains or losses are suggestive.

When the variable moisture content of the fresh grass is removed from the data by calculation and the results placed upon the water free basis, it is still more apparent that tillage has a beneficial effect upon the protein content of pasture grass. It will be noticed in Curve I. Chart XV. that the largest benefit is produced in the early grass. With some fluctuations the benefits of the influence of tillage diminish as the pasture season progresses.

Influence of Manure

The data for the influence of manure upon the percent protein in pasture grass is found in the same tables and charts with the data upon tillage protein content. The second column of the tables and the second curve of the charts contain these results. Upon the fresh basis the grass from the manured plot shows a substantial gain (0.70 percent) in percent protein for the first two months. However, beginning with July and extending with diminishing significance, a loss is noted for the remainder of the season. Except for July this loss is small and probably insignificant.

On the other hand, these results when reduced to the water free basis show the real effect of manuring upon the protein content of the grass. Beginning with the minimum yet significant increase in protein content for the early grass, each succeeding month of the pasture season shows steadily increasing benefits from the manure. These benefits increase as the season progresses, ending with the maximum increase of nearly three times the initial increase in percent of protein produced by manure.

Influence of Frequency of Cutting

The data for the influence of frequency of cutting upon the protein content of grass is found in Tables 19, 20, 21, 22, and Charts XVI., XVII., XVIII. The first column in the tables and the first curve in the charts contain the data showing the effect of biweekly cutting for the check plot (No. I.). Column 2 and 3 and Curves 2 and 3, show the corresponding data for the disced and disced, manured plots respectively.

A study of these tables and charts shows that cutting the grass biweekly instead of weekly decreases the protein content of the grass. This observa-

tion applies to the treated as well as the untreated plots. The results upon the fresh basis, while they suggest this conclusion, fluctuate considerably, showing gains in some instances. The water free basis data brings out this point more clearly. From Chart XVII. it is evident that biweekly cuttings of grass as compared with weekly cutting tends to decrease the percent protein in pasture grass. This tendency increases with the age of the pasture season and with the treatment of the plots The disced,manured plot shows the largest decrease from this cause.

Chart XVIII. shows the average percent protein content of the grass from each plot for the entire pasture season. It will be noted that the grass from plot 7, cut twice yearly and comparable with the check plot in that it was untreated, contained still less protein than the beweekly cut grass. These results indicate that the less frequent pasture grass is cut, the lower will be its protein content.

Table 13 - Protein Content of Pasture Grass for each Cutting from Each Plot

Results in percent of fresh substance

Date cut	No treatment			Disced		Disced and manured	
	Plot 1	Plot 2	Plot 7	Plot 3	Plot 4	Plot 5	Plot 6
	Cut weekly	Cut biweekly	Cut twice a year	Cut weekly	Cut biweekly	Cut weekly	Cut bi-weekly
May 10	4.19	4.30		5.35	4.27	4.87	4.99
" 18	4.24	--		5.09	--	6.81	--
" 25	4.87	4.85		5.73	5.17	6.59	6.25
June 1	5.16	--		5.76	--	6.69	--
" 8	5.41	5.50	4.13	6.11	5.80	6.66	6.05
" 15	6.09	--		6.10	--	6.85	--
" 22	7.45	7.18		8.04	6.66	8.87	7.91
" 29	6.95	--		6.12	--	6.93	--
July 6	6.78	6.10		6.41	5.48	6.44	8.94
" 13	6.37	--		5.54	--	5.85	--
" 20	6.29	5.65		6.04	5.90	7.70	5.87
" 27	6.60	--		4.86	--	6.74	--
Aug. 3	6.46	5.97		5.70	5.45	6.53	6.67
" 10	7.77	--		6.10	--	7.72	--
" 17	5.83	5.69		5.88	4.70	7.35	5.77
" 24	5.84	--		5.14	--	5.99	--
" 31	4.74	4.91		5.04	2.35	4.92	2.64
Sept. 8	3.90	--	5.66	3.44	--	4.88	--
" 14	5.40	4.31		7.87	3.41	4.68	5.11
" 21	5.84	--		5.27	--	6.50	--
" 28	6.53	6.68		6.67	5.89	6.41	6.41
Oct. 7	8.15	--		7.87	--	7.40	--
" 13	7.32	6.61		7.57	6.69	7.49	6.61

Table 14 - Protein Content of Pasture Grass for each Cutting from each Plot

Results in percent of water free substance

	No treatment			Disced		Disced and manured	
	Plot 1	Plot 2	Plot 7	Plot 3	Plot 4	Plot 5	Plot 7
Date cut	Cut weekly	Cut biwoekly	Cut twice a year	Cut weekly	Cut biweekly	Cut weekly	Cut bi-weekly
May 10	14.81	15.12		16.15	15.48	16.59	16.63
" 18	14.15	--		15.70	--	18.75	--
" 25	15.96	15.61		18.19	16.49	21.80	21.32
June 1	16.37	--		18.37	--	22.22	--
" 8	15.77	15.92	8.86	17.82	16.61	21.74	20.57
" 15	17.04	--		18.61	--	23.26	--
" 22	16.28	15.86		17.43	16.75	20.35	19.37
" 29	17.40	--		18.77	--	21.90	--
July 6	20.49	18.92		21.44	19.59	24.10	21.46
" 13	19.30	--		19.85	--	22.78	--
" 20	19.37	19.74		19.49	18.26	25.50	21.20
" 27	18.50	--		18.12	--	21.72	--
Aug. 3	18.59	17.99		18.53	16.98	22.13	20.22
" 10	18.54	--		18.57	--	21.94	--
" 17	17.17	15.99		16.66	14.67	20.70	18.00
" 24	19.13	--		19.13	--	24.13	--
" 31	18.17	17.07		18,03	15.48	23.79	20.53
Sept.8	16.28	--	13.06	15.06	--	22.27	--
" 14	17.71	14.29		24.13	11.98	16.94	20.3.
" 21	17.08	--		15.79	--	25.65	--
" 28	20.75	18.94		20.18	17.78	27.01	24.01
Oct. 7	22.89	--		22.49	--	28.84	--
" 13	22.06	20.79		21.35	19.92	28.15	26.23

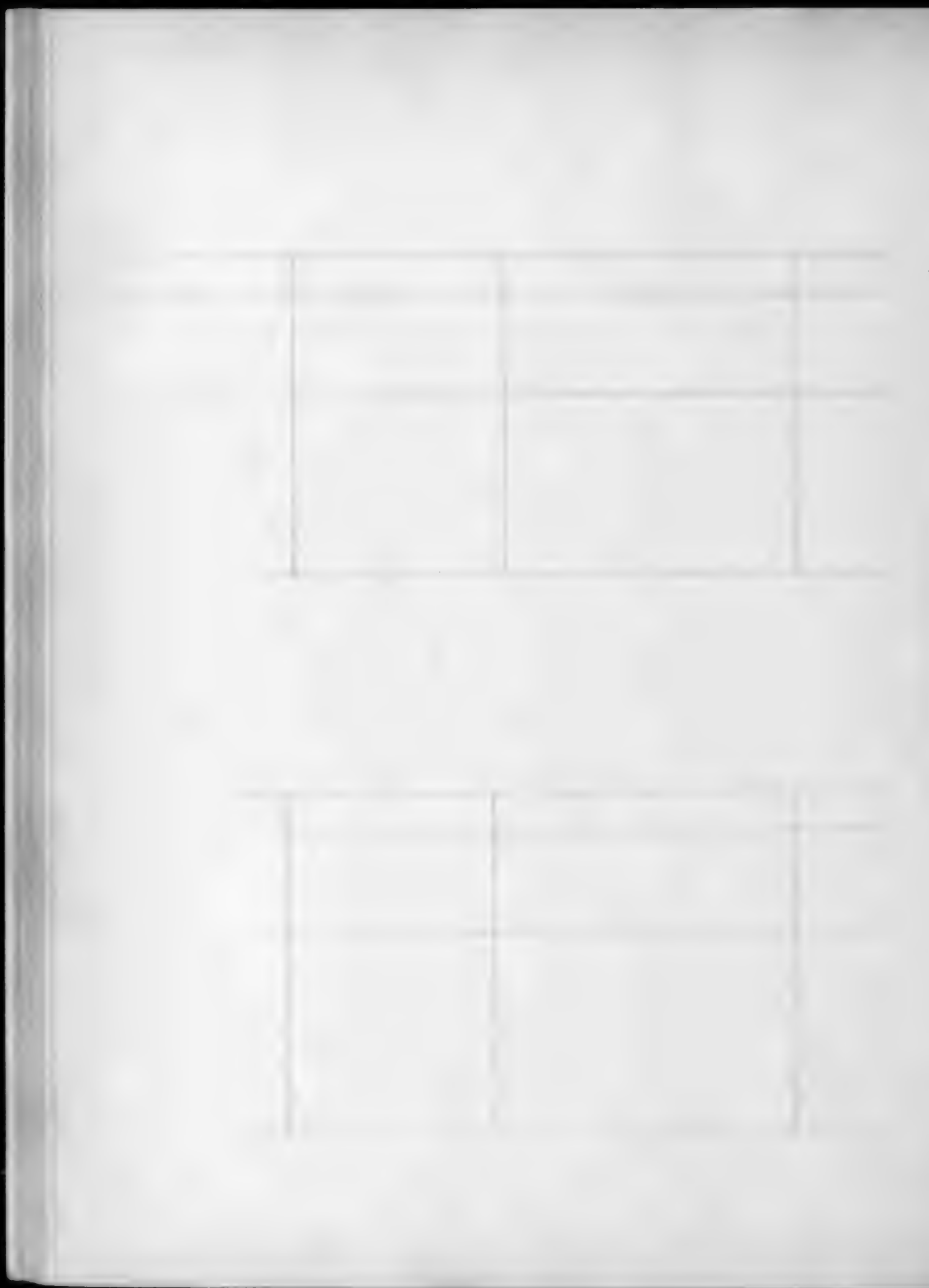


Table 15 - Monthly Variation in Protein Content of Pasture Grass from each Plot

Results in percent of fresh substance

	No treatment			Disced		Disced and manured	
Date cut	Plot 1 cut weekly	Plot 2 cut biweekly	Plot 7 cut twice a year	Plot 3 cut weekly	Plot 4 cut biweekly	Plot 5 cut weekly	Plot 6 cut bi-weekly
May	4.43	4.58	4.13	5.39	4.72	6.09	5.62
June	6.21	6.34		6.43	6.23	7.20	6.98
July	6.51	5.83		5.71	5.69	6.68	7.41
August	6.13	5.52		5.57	4.13	6.50	5.03
September	5.42	5.60	5.66	5.81	4.65	5.61	5.81
October	7.74	6.61		7.72	6.69	7.45	6.61

Table 16 - Monthly Variation in Protein Content of Pasture Grass from each Plot

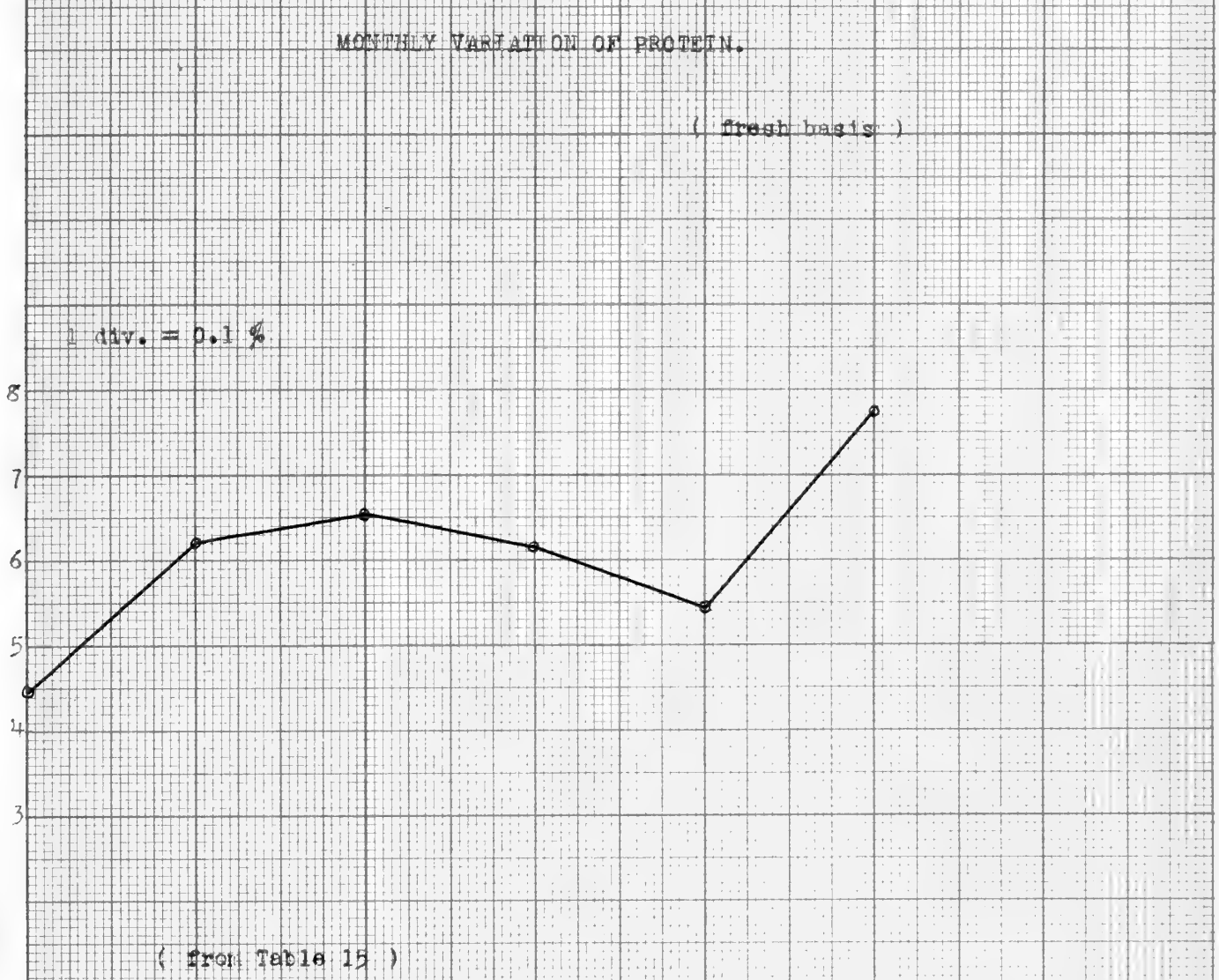
Results in percent of water free substance

	No treatment			Disced		Disced and manured	
Date cut	Plot 1 cut weekly	Plot 2 cut biweekly	Plot 7 cut twice a year	Plot 3 cut weekly	Plot 4 cut biweekly	Plot 5 cut weekly	Plot 6 cut bi-weekly
May	14.94	15.37		16.68	15.99	19.05	18.98
June	16.57	15.89	8.86	18.20	16.68	21.89	19.97
July	19.42	17.33		19.73	19.43	23.53	21.33
August	18.32	17.02		18.18	15.71	22.54	29.38
September	17.96	16.62	13.06	18.79	14.88	22.97	22.16
October	22.48	20.79		21.92	19.92	28.50	26.23

CHART XII.

MONTHLY VARIATION OF PROTEIN.

(fresh basis)

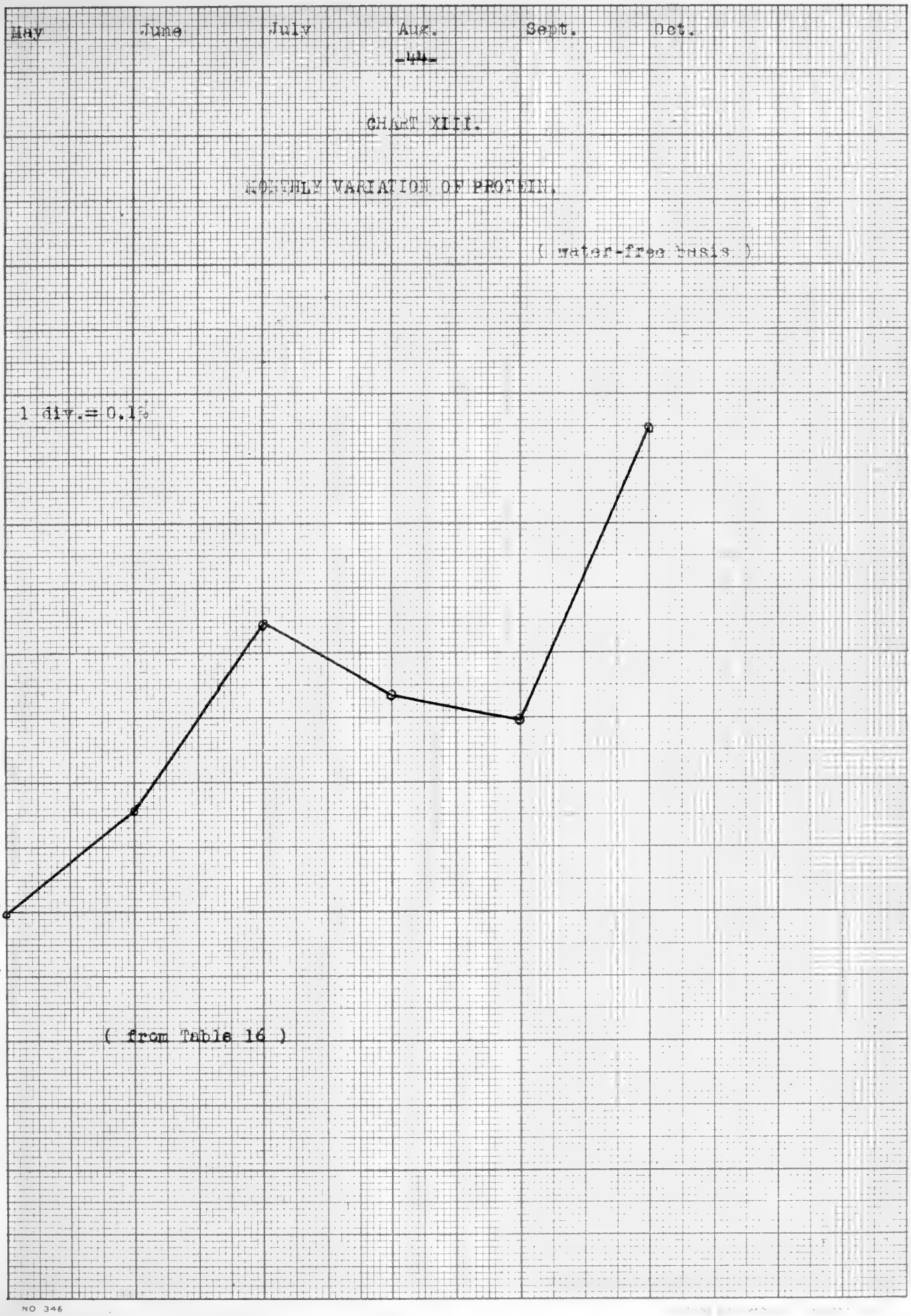


(From Table 15)

CHART XIII.

MONTHLY VARIATION OF PROTEIN.

(water-free basis)



(from Table 16)

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Table 17 - Showing in the First Column the Monthly Variation of the Influence of Tillage upon the Protein Content of Pasture Grass, and in the Second Column the same date for Manure

Results in percent of fresh substance

Month	Increase due to tillage	Increase due to manure
May	+ 0.96	+ 0.70
June	+ 0.22	+ 0.75
July	- 0.81	- 0.64
August	- 0.56	- 0.19
September	+ 0.39	- 0.20
October	- 0.02	- 0.27

Table 18 - Showing in the First Column the Monthly Variation of the Influence of Tillage upon the Protein Content of Pasture Grass and in the Second Column the same data for Manure

Results in percent water free substence

Month	Increase due to tillage	Increase due to tillage
May	+ 1.74	+ 2.37
June	+ 0.63	+ 3.69
July	+ 0.31	+ 3.80
August	- 0.14	- 4.36
September	+ 0.83	+ 4.18
October	- 0.56	+ 6.58

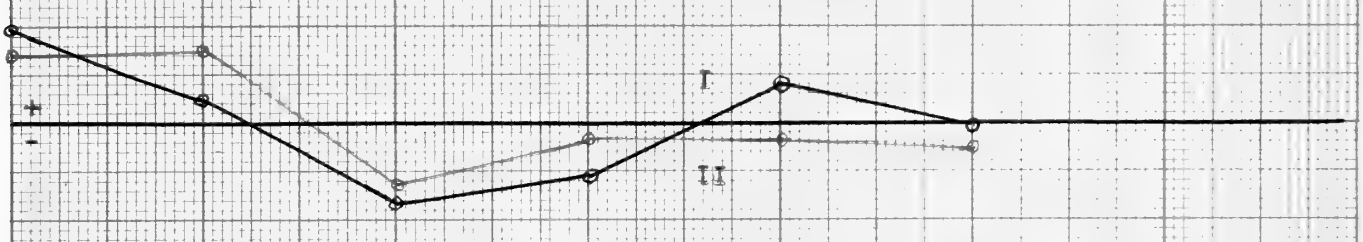
CHART XIV.

INFLUENCE OF TILLAGE AND MANURE UPON THE PROTEIN CONTENT OF PASTURE GRASS

(fresh basis)

Curve I = increase or decrease due to tillage

CurveII = increase or decrease due to manure



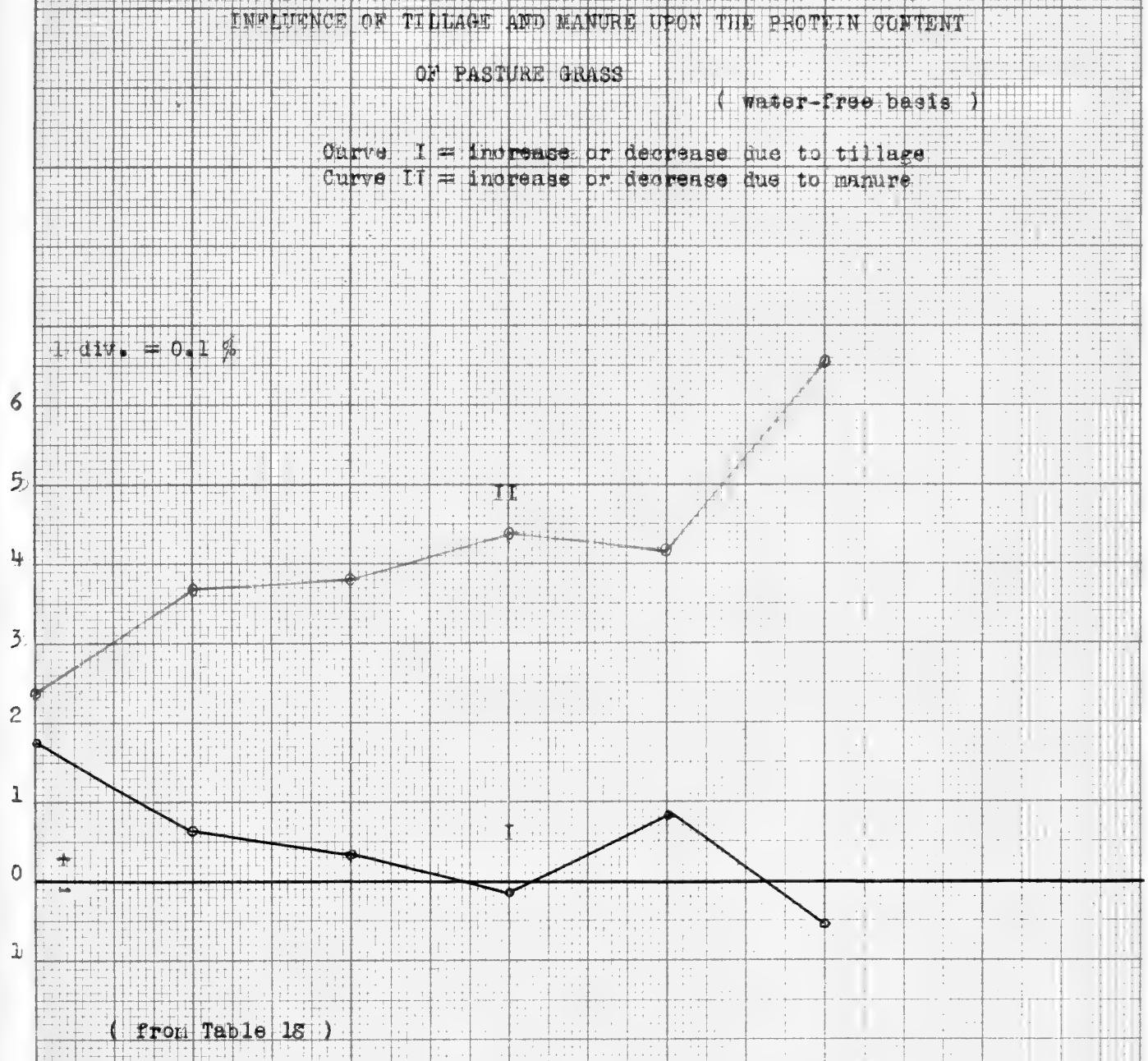
(from Table 17)

CHART XV.

INFLUENCE OF TILLAGE AND MANURE UPON THE PROTEIN CONTENT OF PASTURE GRASS

(water-free basis)

Curve I = increase or decrease due to tillage
Curve II = increase or decrease due to manure



(from Table 18)

Table 19 - Protein Content of Pasture Grass, weekly Cut Plot Averaged to Compare with bi-weekly Cut Plots

Results in percent of fresh substance

	No treatment			Disced		Disced and manured	
Date Cut	Plot 1 Cut weekly	Plot 2 Cut biweekly	Plot 7 Cut twice a year	Plot 3 Cut weekly	Plot 4 Cut biweekly	Plot 5 Cut weekly	Plot 6 Cut bi-weekly
May 10	4.19	4.30		5.35	4.27	4.87	4.99
" 25	4.56	4.85		5.41	5.17	6.70	6.25
June 8	5.29	5.50	4.13	5.94	5.80	6.68	6.05
" 22	6.77	7.18		7.07	6.66	7.86	7.91
July 10	6.87	6.10		6.27	5.48	6.68	8.94
" 20	6.33	5.65		5.79	5.90	6.78	5.87
Aug. 3	6.53	5.97		5.23	5.45	6.64	6.67
" 17	6.80	5.69		5.99	4.70	7.54	5.77
" 31	5.29	4.91		5.09	2.35	5.46	2.64
Sept.14	4.65	4.31	5.66	5.66	3.41	4.78	5.11
" 28	6.19	6.68		5.97	5.89	6.46	6.41
Oct. 13	7.74	6.61		7.72	6.69	7.45	6.61

Table 20 - Protein Content of Pasture Grass. A Comparison of Plots Cut Biweekly with Plots Cut Weekly

Results in percent of fresh substance

Date	Difference between Check Plots	Difference between Disced Plots	Difference between Disced and manured plots
May 10	+ 0.11	- 1.08	+ 0.12
" 25	+ 0.29	- 0.24	- 0.45
June 8	+ 0.21	- 0.14	- 0.63
" 22	+ 0.41	- 0.41	+ 0.05
July 10	- 0.77	- 0.79	+ 0.26
" 20	- 0.68	+ 0.11	- 0.91
Aug. 3	- 0.56	+ 0.22	- 0.03
" 17	- 1.11	- 1.79	- 1.77
" 31	- 0.38	- 2.74	- 2.82
Sept.14	- 0.34	- 2.25	+ 0.33
" 28	+ 0.49	- 0.08	- 0.05
Oct. 13	- 1.13	- 1.03	- 0.84

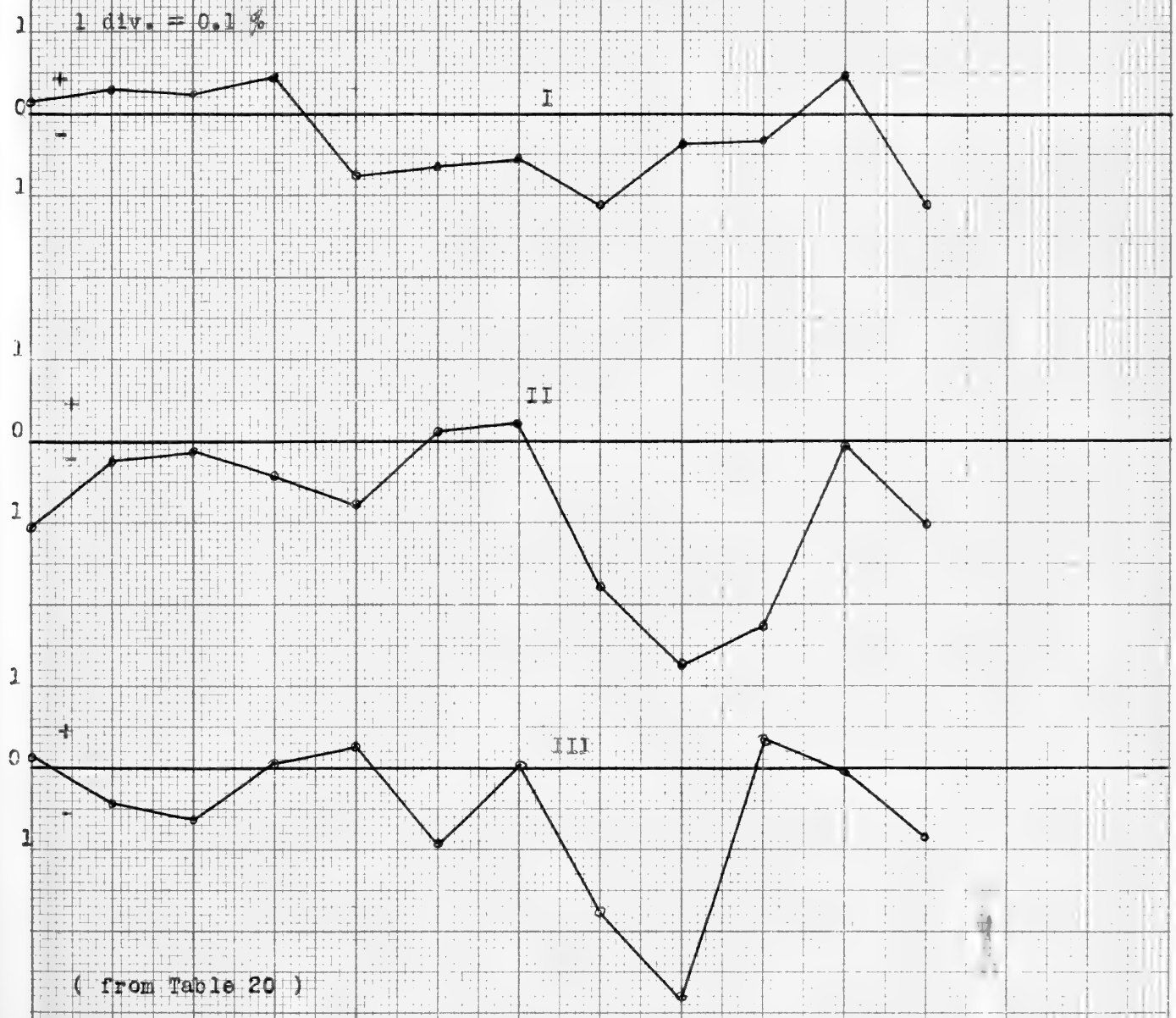
May 10 | June 25 | 8 | July 22 | 6 | 22 | Aug. 3 | 17 | 31 | Sept. 14 | 28 | Oct. 13

CHART XVI.

INFLUENCE OF FREQUENCY OF CUTTING UPON THE PROTEIN CONTENT OF PASTURE GRASS

(fresh basis)

I - Untreated plot cut biweekly
II - Disced plot cut biweekly
III - Disced, manured plot cut biweekly



(from Table 20)

Table 21 - Protein Content of Pasture Grass. Weekly Cut Plots Averaged to Compare with Plots Cut Biweekly

Results in Percent water free substence

Date cut	No treatment			Disced		Disced and manured	
	Plot 1 Cut Weekly	Plot 2 Cut biweekly	Plot 7 Cut twice a year	Plot 3 Cut weekly	Plot 4 Cut biweekly	Plot 5 Cut weekly	Plot 6 Cut bi-weekly
May 10	14.81	15.12		16.15	15.48	16.59	16.63
" 25	15.06	15.61		16.95	16.49	20.28	21.32
June 8	16.07	15.92	8.86	18.10	16.61	21.98	20.57
" 22	16.66	15.86		18.02	16.75	21.81	19.37
July 10	18.95	18.92		20.11	19.59	23.00	21.46
" 20	19.34	19.74		19.67	18.26	24.14	21.20
Aug. 3	18.55	17.99		18.33	16.98	21.93	20.22
" 17	17.86	15.99		17.62	14.67	21.32	18.00
" 31	18.65	17.07		18.58	15.48	23.96	20.53
Sept.14	17.00	14.29	13.06	19.60	11.98	19.61	20.32
" 28	18.92	18.94		17.99	17.78	26.33	24.01
Oct. 13	22.48	20.79		22.42	19.92	28.50	26.23

Table 22 - Protein Content of Pasture Grass. A Comparison of Plots cut biweekly with Plots cut weekly

Results in percent water free substance

Date	Difference between Check plots	Difference between Disced plots	Difference between Disced and manured plots
May 10	+ 0.31	- 0.67	+ 0.04
" 25	+ 0.55	- 0.46	+ 1.04
June 8	- 0.15	- 1.49	- 1.41
" 22	- 0.80	- 1.27	- 2.44
July10	- 0.03	- 0.52	- 1.54
" 20	+ 0.40	- 1.41	- 2.94
Aug. 3	- 0.56	- 1.35	- 1.71
" 17	- 1.87	- 2.95	- 3.32
" 31	- 1.58	- 3.10	- 3.43
Sept.14	- 2.71	- 7.62	+ 0.71
" 28	+ 0.02	- 0.21	- 2.32
Oct.13	- 1.69	- 2.50	- 2.27

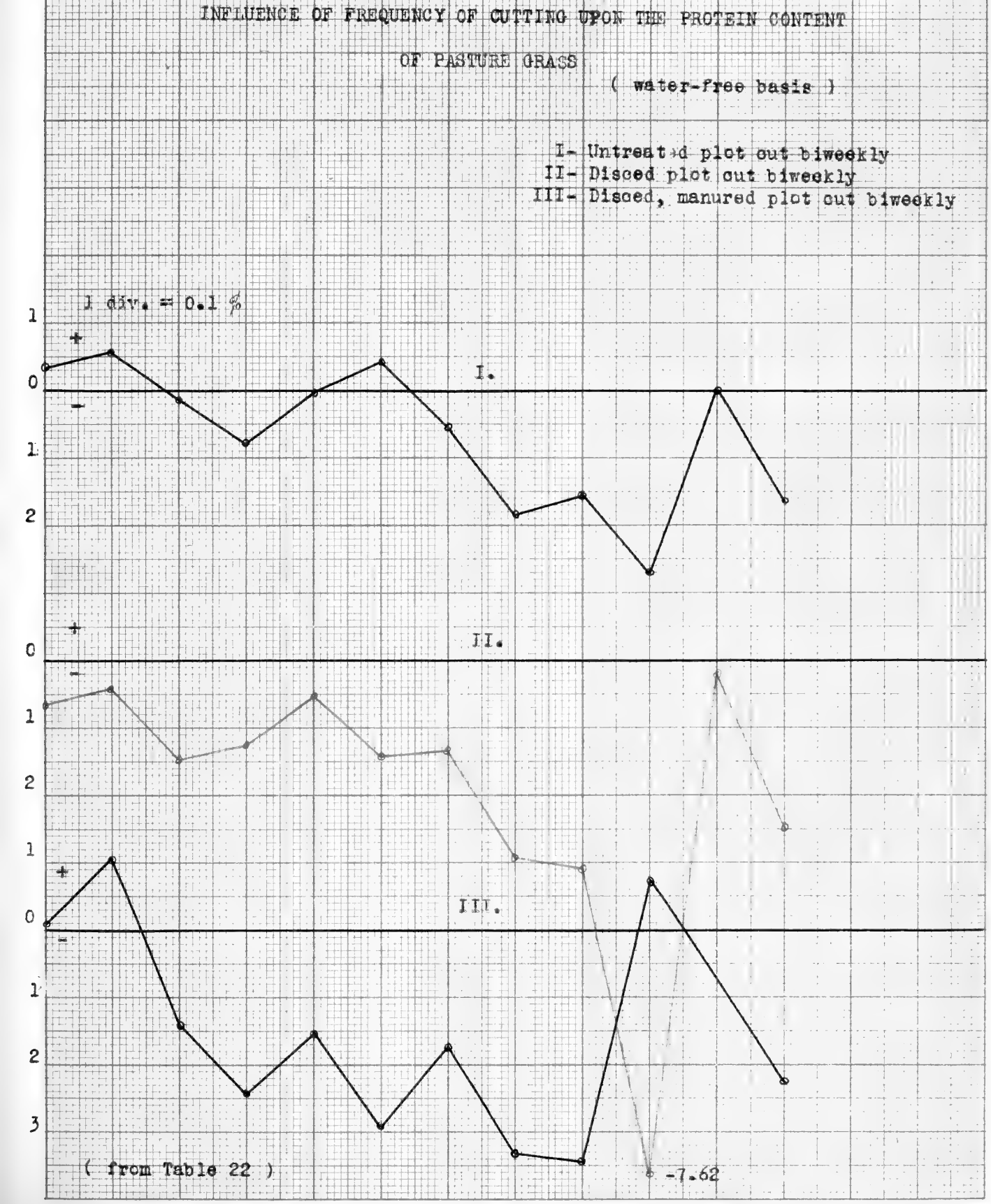
May		June		July		Aug.			Sept.		Oct.
10	25	8	22	6	22	3	17	31	14	28	13

CHART XVII.

INFLUENCE OF FREQUENCY OF CUTTING UPON THE PROTEIN CONTENT OF PASTURE GRASS

(water-free basis)

I- Untreated plot cut biweekly
II- Disced plot cut biweekly
III- Disced, manured plot cut biweekly



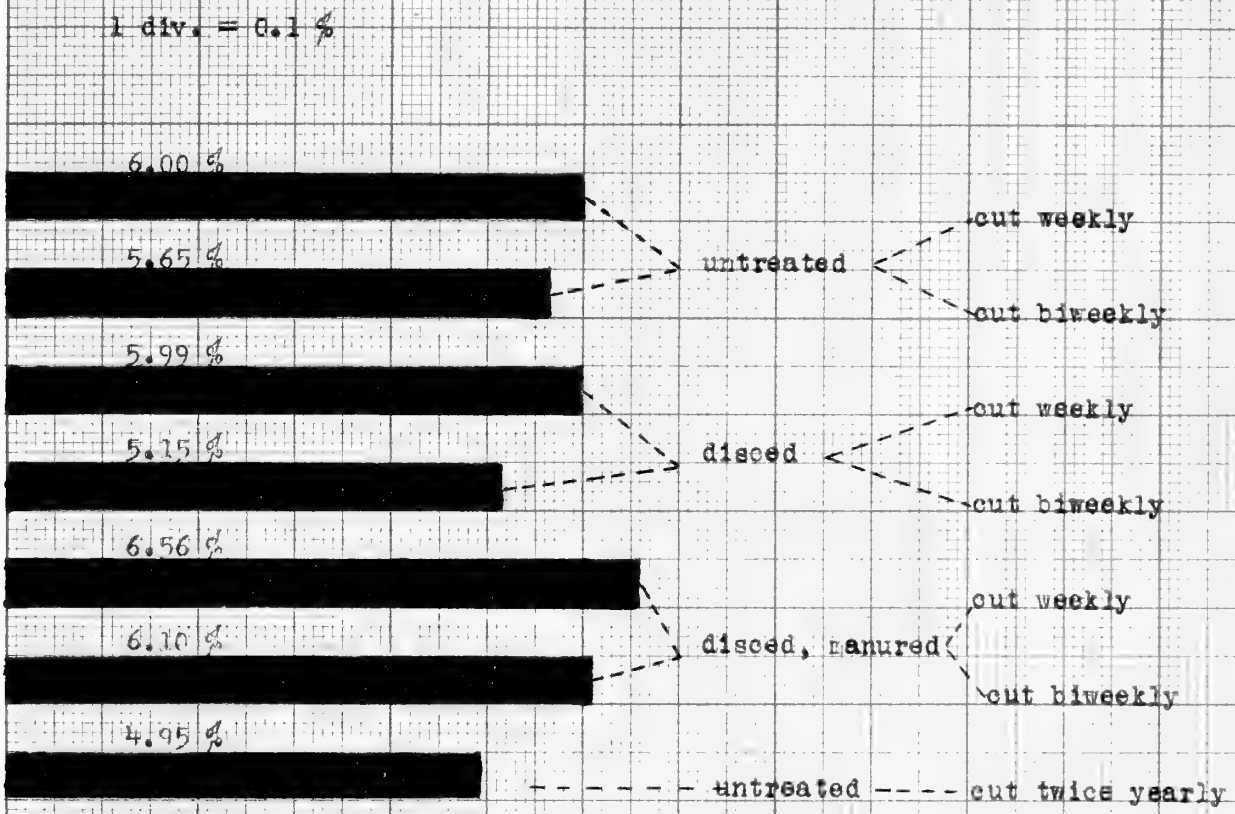
(from Table 22) -7.62

NO 346

CHART XVIII.

AVERAGE PROTEIN CONTENT OF PASTURE GRASS FROM EACH PLOT FOR THE SEASON OF 1910.

(fresh basis)



ETHER EXTRACT

Influence of the Age of the Pasture Season

The data bearing upon the influence of the age of the pasture season upon the ether extract content of pasture grass is found in Tables 23, 24, 25, and 26, and Charts XIX. and XX. In terms of the fresh grass this constituent varies from 1.07 to 1.90 percent. The minimum percent represents the content of early grass, while the maximum represents the August grass. The curve in Chart XIX. shows the content as it varies from month to month through the season. Upon the fresh basis the percent of this constituent increases from the opening of the season, with a slight drop for July, until August. From this point to the end of the season the ether extract content remains practically constant.

Examined from the view point of the water free basis the results are practically the same, except that July shows an increase over June, giving a steady rise in percent of ether extract from May to August. After August there is a decline for the remainder of the season, with the October grass richer in ether extract than the September grass. From these data it appears therefore that the ether extract content of pasture grass increases for about the first two thirds of the pasture season, when decline follows to a degree of richness equal to about the average percent of this constituent for the season

Influence of Tillage

The data upon the influence of tillage upon the ether extract content of grass is found in the first column of Tables 27 and 28 and in the first curve in Charts XXI. and XXII. From the data here presented it appears that

discing pastures causes a decrease in the percent of ether extract in the grass. While the decrease is small, ranging from 0.11 to 0.26 percent (fresh basis) it is consistent enough from the standpoint of both the fresh basis and the water free basis to attract attention. Although the results upon this point can be regarded in no way as conclusive, they suggest that discing has a tendency to lower the percent ether extract in pasture and moreover this tendency increases with the age of the pasture season.

Influence of Manuring

The data for the influence of manuring upon the ether extract content of pasture grass is found in the second column of Tables 27 and 28 and the second curve of Charts XXI. and XXII. The results relating to the influence of manure in this connection do not admit of as easy interpretation as the tillage data.

From the fresh basis it appears that the manure also has a depressing effect upon the percent of ether extract in the grass. The exception in the data to this statement is the June results. Here a marked beneficial effect is noted.

When the results are considered from the water free basis a still greater number of exceptions are in evidence. It would seem,therefore, considering the data from both the fresh basis, and the water free basis,that the depressing effect of manure, upon the percent of ether extract in grass, is confined to that cut in mid-season (July and August.) Upon the grass cut the remaining portions of the pasture season a beneficial effect is to be expected.

Influence of Frequency of Cutting

The data for the influence of frequency of cutting upon the ether extract content of grass is found in Tables 29, 30, 31, 32 and Charts XXIII. and XXIV. The first column in the tables and the first curve in the charts contains the data showing the effect of biweekly cutting for the check plot (No. 1.) Column 2 and 2 and curves 2 and 3 show the corresponding data for the disced and disced, manured plots respectively.

From a study of these tables and charts it appears that the general tendency of cutting grass every two weeks instead of every week is to increase the ether extract content of the grass. It does not matter whether the results are considered from the fresh basis or the water free basis, - this statement appears true. Chart XXIV. in which the data is reduced to a graphic representation upon the water free basis, brings out the point to best advantage. It should be noted that in the case of the check plot, a decrease in ether extract is produced during the latter third of the season. In the cases of the disced plot and the disced, manured plot there are 2 or 3 instances where a loss is recorded. These should be regarded as exceptions, rather than the rule.

From the data, it seems safe to say that the less frequent grass is cut the greater is the tendency for the percent of ether extract to diminish.

Table 23 - Ether Extract Content of Pasture Grass for each Cutting from each Plot

Results in percent of fresh substance

Date cut	No treatment			Disced		Disced and manured	
	Plot 1 Cut weekly	Plot 2 Cut biweekly	Plot 7 Cut twice a year	Plot 3 Cut weekly	Plot 4 Cut biweekly	Plot 5 Cut weekly	Plot 6 Cut biweekly
May 10	1.12	1.03		1.19	1.04	0.99	1.02
" 18	1.05	--		0.90	--	1.04	--
" 25	1.04	1.22		1.12	1.17	1.20	1.10
June 1	1.03	--		1.05	--	1.01	--
" 8	1.26	1.34	1.14	1.44	1.23	1.16	1.11
" 15	1.37	--		1.28	--	1.22	--
" 22	2.19	2.11		2.16	1.90	2.07	2.13
" 29	2.43	--		1.37	--	1.50	--
July 6	1.73	1.87		1.51	1.38	1.27	2.13
" 13	1.71	--		1.39	--	1.21	--
" 20	1.63	1.60		1.46	1.82	1.11	1.40
" 27	2.06	--		1.32	--	1.54	--
Aug. 3	1.99	2.05		1.75	1.86	1.45	1.77
" 10	2.39	--		1.74	--	1.63	--
" 17	1.88	1.96		1.85	1.80	1.73	1.91
" 24	1.90	--		1.45	--	1.21	--
" 31	1.36	1.57		1.42	0.89	1.04	0.70
Sept. 8	1.07	--	2.69	0.92	--	0.90	--
" 14	1.54	1.19		1.44	0.91	0.97	1.08
" 21	1.55	--		1.14	--	1.10	--
" 28	1.52	1.57		1.42	1.53	1.14	1.30
Oct. 7	1.77	--		1.57	--	1.41	--
" 13	1.79	1.62		1.49	1.60	1.43	1.22

Table 24 - Ether Extract Content of Pasture Grass for each Cutting from each Plot

Results in percent of water free substance

Date cut	No treatment			Disced		Disced and manured	
	Plot 1 Cut weekly	Plot 2 Cut biweekly	Plot 7 Cut twice a year	Plot 3 Cut weekly	Plot 4 Cut biweekly	Plot 5 Cut weekly	Plot 6 Cut biweekly
May 10	3.98	3.61		3.58	3.77	3.38	3.39
" 18	3.52	--		2.76	--	2.87	--
" 25	3.42	3.93		3.55	3.72	3.98	3.74
June 1	3.26	--		3.36	--	3.35	--
" 8	3.67	3.88	2.45	4.19	3.52	3.79	3.78
" 15	3.84	--		3.90	--	4.15	--
" 22	4.78	4.67		4.67	4.77	4.74	5.22
" 29	6.08	--		4.21	--	4.73	--
July 6	5.23	5.79		5.06	4.92	4.75	5.11
" 13	5.18	--		4.98	--	4.71	--
" 20	5,02	5.59		4.71	5.62	3.69	5.04
" 27	5.77	--		4.92	--	4.95	--
Aug. 3	5.73	6.19		5.68	5.80	4.90	5.37
" 10	5.71	--		5.30	--	4.64	--
" 17	5.52	5.51		5.24	5.62	4.87	5.95
" 24	6.21	--		5.40	--	4.89	--
" 31	5.20	5.44		5.07	5.86	5.04	5.47
Sept. 8	4.47	--	6.21	4.02	--	4.10	--
" 14	5.04	3.95		4.42	3.20	3.52	4.28
" 21	4.53	--		3.42	--	4.33	--
" 28	4.84	4.44		4.31	4.61	4.78	4.89
Oct. 7	4.96	--		4.49	--	5.50	--
" 13	5.39	5.10		4.21	4.75	5.37	4.83

Table 25 - Monthly Variation of Ether Extract Content of Pasture Grass from each Plot

Results in percent of fresh substance

	No treatment			Disced		Disced and manured	
Date cut	Plot 1 cut weekly	Plot 2 cut biweekly	Plot 7 cut twice a year	Plot 3 cut weekly	Plot 4 cut biweekly	Plot 5 cut weekly	Plot 6 cut bi-weekly
May	1.07	1.13		1.07	1.11	1.08	1.06
June	1.66	1.73	1.14	1.46	1.57	2.04	1.62
July	1.53	1.74		1.42	1.60	1.28	1.77
August	1.90	1.86		1.64	1.52	1.41	1.46
September	1.87	1.38	2.69	1.64	1.22	1.03	1.19
October	1.78	1.62		1.53	1.60	1.42	1.22

Table 26 - Monthly Variation of Ether Extract Content of Pasture Grass from each Plot

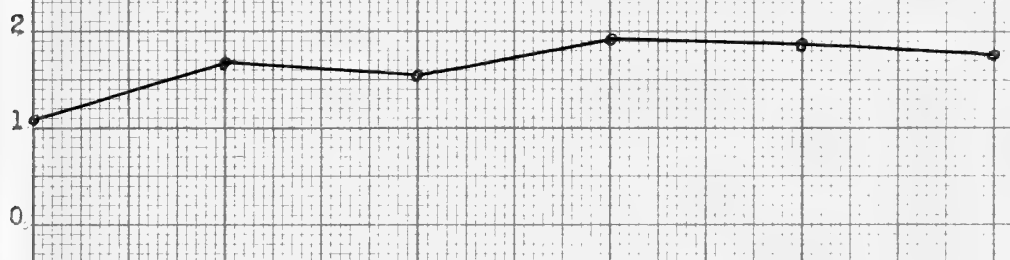
Results in percent of water free substance

	No treatment			Disced		Disced and manured	
Date cut	Plot 1 cut weekly	Plot 2 cut biweekly	Plot 7 cut twice a year	Plot 3 cut weekly	Plot 4 cut biweekly	Plot 5 cut weekly	Plot 6 Cut bi-weekly
May	3.64	3.77		3.30	3.75	3.41	3.57
June	4.33	4.28	2.45	4.07	4.15	4.15	4.50
July	5.30	5.69		4.92	5.27	4.28	5.08
August	5.67	5.71		5.34	5.76	4.87	5.66
September	4.72	4.20	6.21	4.04	3.91	4.18	4.59
October	5.18	5.10		4.35	4.75	5.44	4.83

CHART XIX.

MONTHLY VARIATION OF THE ETHER EXTRACT CONTENT OF PASTURE GRASS

(fresh basis)



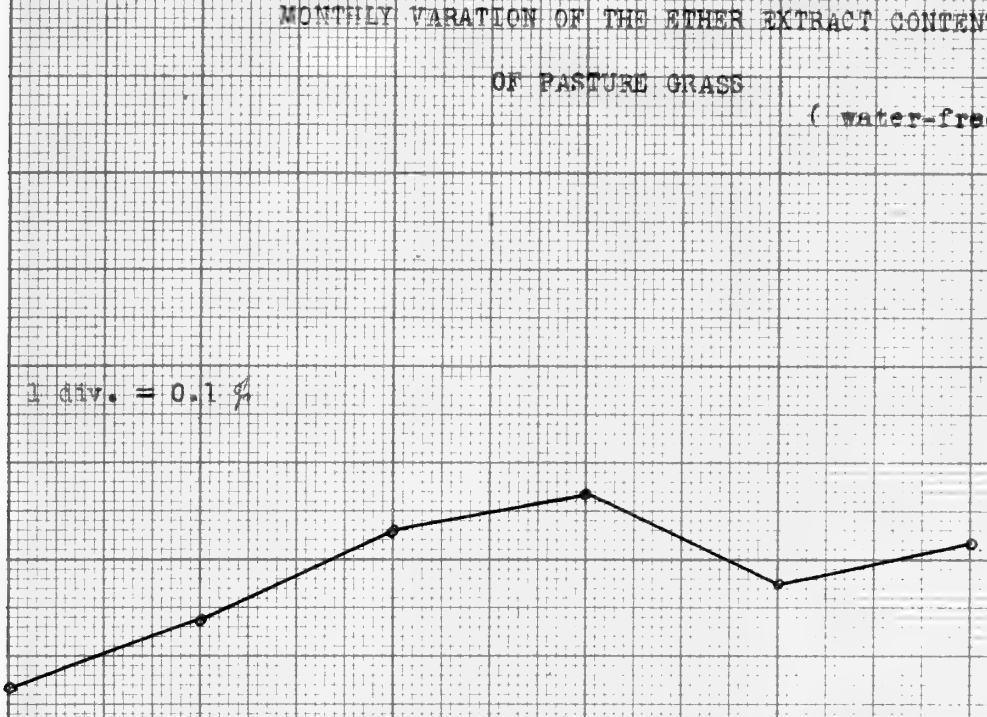
(from Table 25)

CHART XX.

MONTHLY VARIATION OF THE ETHER EXTRACT CONTENT

OF PASTURE GRASS

(water-free basis)



(from table 26)

Table 27 - Showing in the First Column the Monthly Variation of the Influence of Tillage upon the Ether Extract Content of Pasture Grass and in the Second Column the same Data for Manure

Results in percent of fresh substance

Month	Increase due to tillage	Increase due to manure
May	None	+ 0.01
June	- 0.20	+ 0.58
July	- 0.11	- 0.14
August	- 0.26	- 0.23
September	- 0.23	- 0.61
October	- 0.25	- 0.11

Table 28 - Showing in the First Column the Monthly Variation of the Influence of Tillage upon the Ether Extract Content of Pasture Grass and in the Second Column the same Data for Manure

Results in percent of water free substance

Month	Increase due to tillage	Increase due to manure
May	- 0.04	+ 0.11
June	- 0.26	+ 0.08
July	- 0.38	- 0.64
August	- 0.33	- 0.47
September	- 0.68	+ 0.14
October	- 0.83	+ 1.09

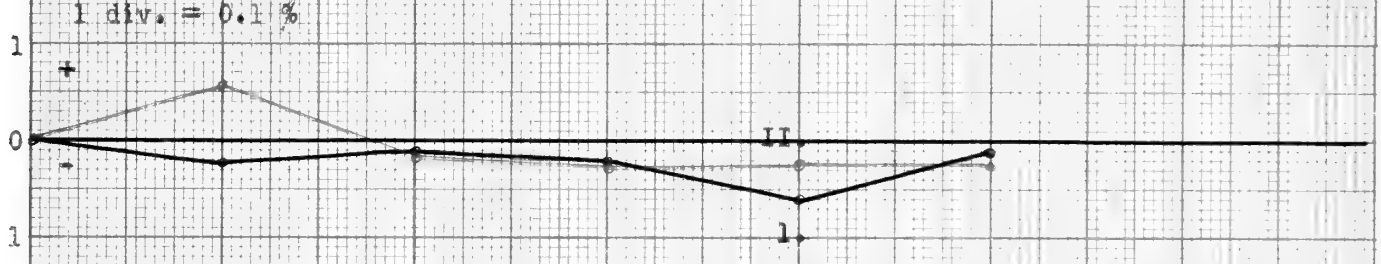
CHART XXI.

INFLUENCE OF TILLAGE AND MANURE UPON THE ETHER EXTRACT CONTENT OF PASTURE GRASS

(fresh basis)

Curve I = increase or decrease due to tillage

Curve II = increase or decrease due to manure



(from Table 27)

NO 346

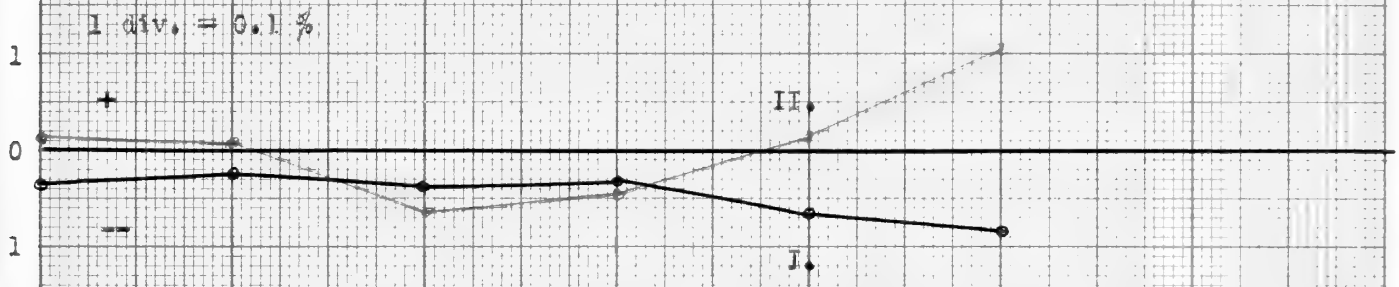
CHART XXII.

INFLUENCE OF TILLAGE AND MANURE UPON THE ETHER EXTRACT CONTENT OF PASTURE GRASS

(water-free basis)

Curve I = increase or decrease due to tillage

Curve II = increase or decrease due to manure



(from Table 28)

Table 29 - Variation in Ether Extract Content of Pasture Grass, cut Plots Averaged to Compare with Biweekly cut Plots

Results in percent of fresh substance

Date cut	No treatment			Disced		Disced and manured	
	Plot 1 Cut weekly	Plot 2 Cut biweekly	Plot 7 Cut twice a year	Plot 3 Cut weekly	Plot 4 Cut biweekly	Plot 5 Cut weekly	Plot 6 Cut bi-weekly
May 10	1.12	1.03		1.19	1.04	0.99	1.02
" 25	1.05	1.22		1.01	1.17	1.12	1.10
June 8	1.15	1.34	1.14	1.25	1.23	1.09	1.11
" 22	1.78	2.11		1.72	1.90	1.65	2.13
July 10	2.08	1.87		1.44	1.38	1.39	2.13
" 20	1.67	1.60		1.43	1.82	1.16	1.40
Aug. 3	2.03	2.05		1.54	1.86	1.50	1.77
" 17	2.14	1.96		1.80	1.80	1.68	1.91
" 31	1.63	1.57		1.44	0.89	1.13	0.70
Sept.14	1.31	1.19	2.69	1.18	0.91	0.94	1.08
" 28	1.54	1.57		1.28	1.53	1.12	1.30
Oct. 13	1.78	1.62		1.53	1.60	1.42	1.22

Table 30 - Variation in Ether Extract Content of Pasture Grass. A Comparison of Plots cut Biweekly with Plots cut Weekly

Results in percent of fresh substance

Date	Difference between untreated Plots	Difference between Disced Plots	Difference between Disced and manured Plots
May 10	- 0.09	- 0.15	+ 0.03
" 25	+ 0.17	+ 0.16	- 0.02
June 8	+ 0.19	- 0.02	+ 0.02
" 22	+ 0.33	+ 0.18	+ 0.48
July 10	- 0.21	- 0.06	+ 0.74
" 20	- 0.07	+ 0.39	+ 0.24
Aug. 3	+ 0.02	+ 0.32	+ 0.27
" 17	- 0.18	None	+ 0.23
" 31	- 0.06	+ 0.45	- 0.43
Sept.14	- 0.12	+ 0.73	+ 0.14
" 28	+ 0.03	+ 0.25	+ 0.18
Oct. 13	- 0.16	+ 0.07	- 0.20

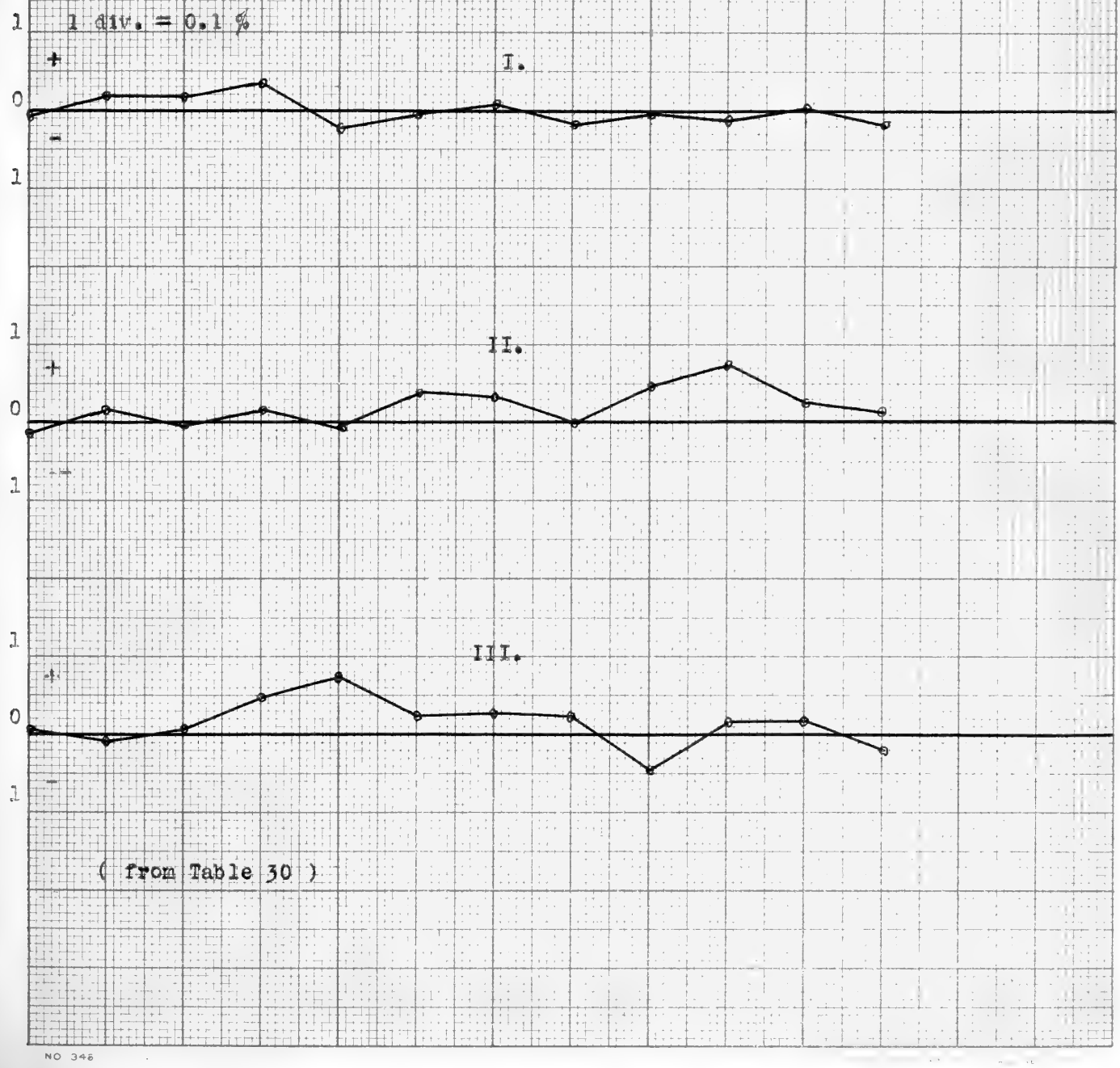
May 10 25 | June 8 22 | July 6 22 | Aug. 5 17 31 | Sept. 14 28 | Oct. 13

CHART XXIII.

INFLUENCE OF FREQUENCY OF CUTTING UPON THE ETHER EXTRACT CONTENT OF PASTURE GRASS

(fresh basis)

I- Untreated plot cut biweekly
II- Disced plot cut biweekly
III- Disced, manured plot cut biweekly



(from Table 30)

NO 346

Table 31 - Variation in Ether Extract Content of Pasture Grass. Weekly cut Plot Averaged to Compare with Biweekly cut Plots

Results in percent of water free substance

Date cut	No treatment			Disced		Disced and manured	
	Plot 1 Cut weekly	Plot 2 Cut biweekly	Plot 7 Cut twice a year	Plot 3 Cut weekly	Plot 5 Cut biweekly	Plot 6 Cut weekly	Plot 7 Cut bi-weekly
May 10	3.98	3.61		3.58	3.77	3.38	3.39
" 25	3.47	3.93		3.16	3.72	3.43	3.74
June 8	3.47	3.88	2.45	3.78	3.52	3.57	3.78
" 22	4.31	4.67		4.28	4.77	4.45	5.22
July 10	5.66	5.79		4.63	4.92	4.74	5.11
" 20	5.10	5.59		4.85	5.62	4.20	5.04
August 3	5.75	6.19		5.30	5.80	4.93	5.37
" 17	5.62	5.51		5.27	5.62	4.76	5.95
" 31	5.71	5.44		5.24	5.86	4.97	5.47
Sept. 14	4.76	3.95	6.21	4.22	3.20	3.81	4.28
" 28	4.69	4.44		3.87	4.61	4.56	4.89
Oct. 13	5.18	5.10		4.35	4.75	5.44	4.83

Table 32 - Variation in Ether Extract Content of Pasture Grass. A Comparison of Plots cut Biweekly with Plots cut Weekly

Results in percent of water free basis

Date	Difference between untreated plots	Difference between disced plots	Difference between disced and manured plots
May 10	- 0.37	+ 0.19	+ 0.01
" 25	+ 0.46	+ 0.56	+ 0.31
June 8	+ 0.41	- 0.26	+ 0.21
" 22	+ 0.36	+ 0.49	+ 0.77
July 10	+ 0.13	+ 0.29	+ 0.37
" 20	+ 0.49	+ 0.77	+ 0.84
Aug. 3	+ 0.44	+ 0.50	+ 0.44
" 17	- 0.11	+ 0.35	- 1.19
" 31	- 0.27	+ 0.62	+ 0.50
Sept. 14	-.0.81	- 1.02	+ 0.47
" 28	-.0.25	+ 0.74	+ 0.33
Oct. 13	- 0.08	+ 0.40	- 0.61

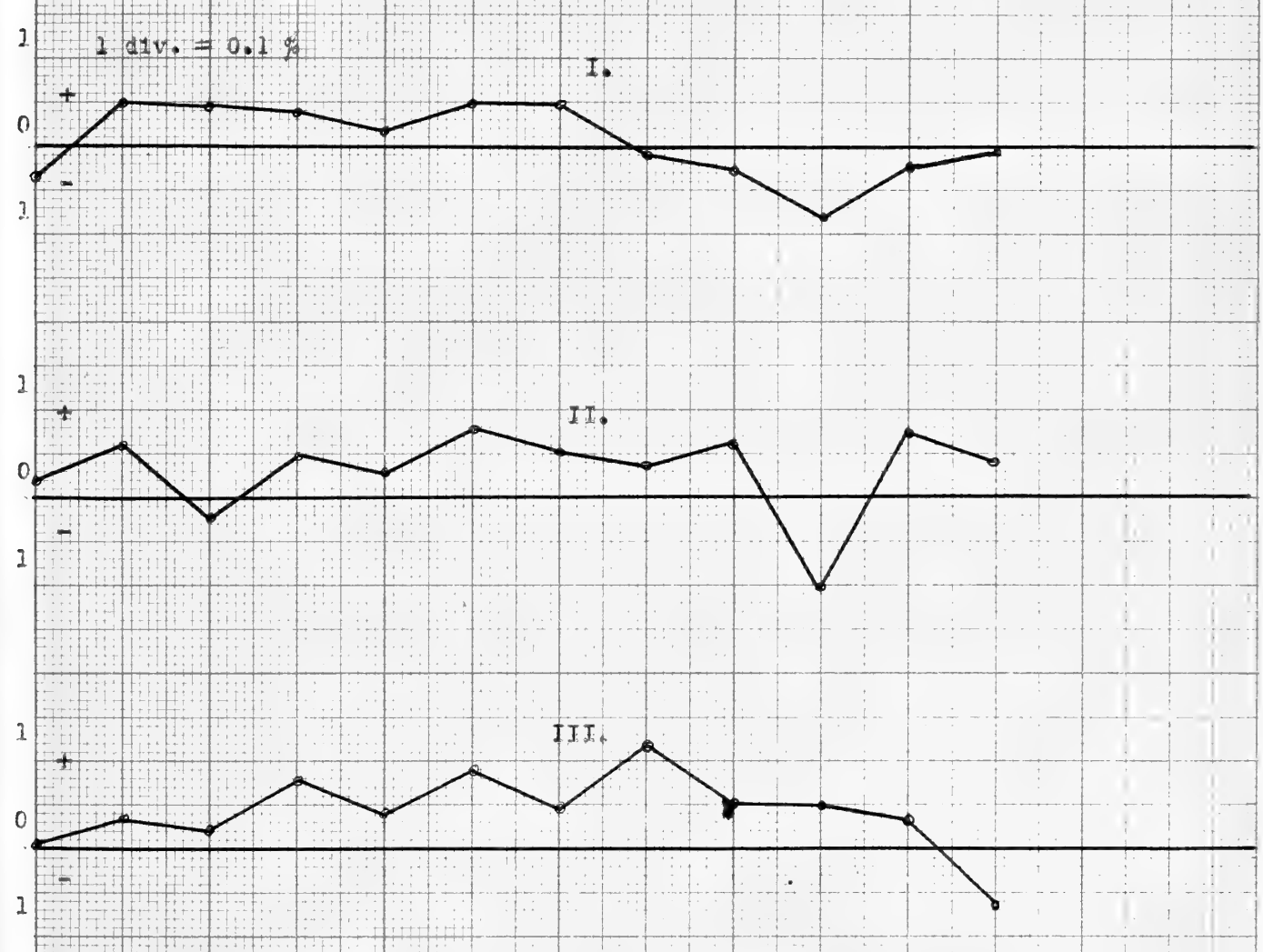
May 10 25 | June 8 22 | July 6 22 | Aug. 3 17 31 | Sept. 14 28 | Oct. 13

CHART XXIV.

INFLUENCE OF FREQUENCY OF CUTTING UPON THE ETHER EXTRACT CONTENT OF PASTURE GRASS

(water-free basis)

I - Untreated plot cut biweekly
II - Disced plot cut biweekly
III - Disced, manured plot cut biweekly



(from Table 32)

NO 346

ASH

Influence of the Age of Pasture Season

The data for the influence of the age of the pasture season upon the ash content of grass is found in Tables 33, 34, 35 and 36,and Charts XXV. and XXVI. A study of this data shows that the percent of ash in the fresh grass varies from 2.10 to 3.88 percent. The grass cut in June contains the largest amount of ash, while the September grass contains the smallest amount. As to the variation of this constituent throughout the season, the May grass starts with a content of 2.68 percent, while June follows with 3.88 percent. At this point in the season the percent of ash commences to fall. This decline continues through July and August to 2.10 percent in September.An Increase develops,however,in the late grass.This October grass ranks second in ash content, about one-half to one percent above the early grass.

Considered from both the fresh basis and the water free basis, after June, the grass suffers a decline in ash content until the last month of the pasture season, when a rise of about 0.75 percent develops.

Influence of Tillage

The data for the influence of tillage upon the ash content of pasture grass is found in the first column of Tables 37 and 38 and the first curve in Charts XXVII.and XXVIII. From the results upon this point it appears that during the summer months of the pasture season the effect of tillage is to lower the ash content of the grass. Charts XXVII.and XXVIII. show this point quite clearly. The effect upon the early and late grass, however, is to increase the ash content. This depressing effect of tillage upon the ashcontent amount to from 0.34 to 0.49 percent, while the benefits derived,

amount to increases varying from 0.16 to 0.80 percent on the fresh basis.

The Influence of Manure

The data for the effect of manure upon the percent ash in pasture grass is found, as in the other cases, along with the tillage data in Tables 37, and 38, and Charts XXVII. and XXVIII. This particular data is found in the second column of the tables and the second curve of the charts.

From a study of the charts, it is evident that manuring has a tendency to increase the percent ash in grass. With the latter part of the season as an exception, this statement is prompted by the trend of the second curve in Chart XXVII. The corresponding curve of the water free basis data is strong evidence supporting the statement. It appears, therefore, that throughout the season a uniform increase (water free basis) of about 0.76 percent in the ash content is produced by manure. The October grass is the single exception where a considerable loss is apparent.

The Influence of Frequency of Cutting

The data upon the influence of frequency of cutting, upon the ash content of pasture grass, is found in Tables 39, 40, 41, and 52 and in Charts XXIX. and XXX. The first column in the tables and the first curve in the charts contain the data showing the effect of the biweekly cutting for the check plot (No.1) Columns 2 and 3 and curves 2 and 3, show the corresponding data for the disced and disced, manured plots, respectively.

A study of the tables and charts upon this subject indicate that there is a tendency to a reduced ash content in grass that is cut biweekly instead of weekly. This is particularly true in the case of the disced plot when considered in the light of the water free basis. Out of 12 observations only

three show any increase in ash content. As for the check plot and the disced manured plot, four observations show an increase. In spite of these exceptions it may be said therefore that the ash content of grass is decreased slightly where it is cut biweekly instead of weekly. This applies to all of the plots in this experiment. The loss is small and uniform in each case except that of the disced plot. In this case the early and late grass show a somewhat more pronounced decline in percent of ash.

Table 33 - Ash Content of Pasture Grass for each Cutting from each Plot

Results in percent of fresh substance

	No treatment			Disced		Disced and manured	
Date cut	Plot 1 cut weekly	Plot 2 cut biweekly	Plot 7 cut twice a year	Plot 3 cut weekly	Plot 4 cut biweekly	Plot 5 cut weekly	Plot 6 cut bi-weekly
May 10	2.48	2.33		3.22	2.46	2.83	2.82
" 18	2.80	--		3.36	--	4.06	--
" 25	2.77	2.84		2.86	2.80	3.29	3.30
June 1	3.43	--		3.36	--	3.57	--
" 8	3.47	3.42	3.50	3.23	3.05	3.02	3.11
" 15	3.60	--		3.24	--	2.88	--
" 22	5.03	4.86		4.50	4.02	4.26	4.10
" 29	3.87	--		2.86	--	2.72	--
July 6	2.90	2.79		2.49	2.33	2.26	3.46
" 13	2.73	--		2.17	--	2.13	--
" 20	2.70	2.47		2.51	2.66	2.93	2.39
" 27	2.95	--		2.15	--	2.68	--
Aug. 3	2.76	2.69		2.33	2.49	2.44	2.83
" 10	3.36	--		2.45	--	2.80	--
" 17	2.55	2.72		2.50	2.21	2.66	2.43
" 24	2.24	--		1.87	--	1.94	--
" 31	1.90	2.11		1.94	1.04	1.68	1.02
Sept. 8	1.45	--	3.85	1.37	--	1.73	--
" 14	2.16	1.84		2.69	1.55	2.03	1.90
" 21	2.35	--		2.40	--	2.12	--
" 28	2.44	2.79		2.57	2.32	2.12	2.27
Oct. 7	3.00	--		3.00	--	2.23	--
" 13	2.92	2.92		4.52	3.67	2.49	2.43

Table 34 - Ash Content of Pasture Grass for each Cutting from each Plot

Results in percent of water free substance

Date cut	No treatment			Disced		Disced and manured	
	Plot 1 Cut weekly	Plot 2 Cut biweekly	Plot 7 Cut twice a year	Plot 3 Cut weekly	Plot 4 Cut beweekly	Plot 5 Cut weekly	Plot 6 Cut bi-weekly
May 10	8.77	8.21		9.71	8.92	9.64	9.38
" 18	9.35	--		10.35	--	11.19	--
" 25	9.09	9.16		9.08	8.94	10.90	11.24
June 1	10.89	--		10.71	--	11.86	--
" 8	10.12	9.91		9.43	8.72	9.86	10.58
" 15	10.08	--		9.88	--	9.79	--
" 22	10.98	10.73		9.76	10.11	9.78	10.04
" 29	9.69	--		8.78	--	8.59	--
July 6	8.78	8.66		8.32	8.33	8.44	8.31
" 13	8.30	--		7.78	--	8.30	--
" 20	8.32	8.64	7.50	8.11	8.23	9.70	8.62
" 27	8.27	--		8.03	--	8.64	--
Aug. 3	7.95	8.10		7.58	7.74	8.27	8.59
" 10	8.02	--		7.45	--	7.95	--
" 17	7.49	7.64		7.08	6.92	7.49	7.58
" 24	7.32	--		6.97	--	7.79	--
" 31	7.31	7.32		6.94	6.86	8.14	7.90
Sept. 8	6.07	--	8.89	5.99	--	7.90	--
" 14	7.10	6.12		8.24	5.47	7.35	7.58
" 21	6.86	--		7.20	--	8.37	--
" 28	7.76	7.91		7.77	7.00	8.94	8.49
Oct. 7	8.42	--		8.56	--	8.71	--
" 13	8.80	9.18		12.75	10.92	9.35	9.64

Table 35 - Monthly Variation of Ash Content of Pasture Grass from each Plot

Results in percent of fresh substance

	No treatment			Disced		Disced and manured	
Month	Plot 1 cut weekly	Plot 2 cut biweekly	Plot 7 cut twice a year	Plot 3 cut weekly	Plot 4 cut biweekly	Plot 5 cut weekly	Plot 6 cut bi-weekly
May	2.68	2.59		3.15	2.63	3.39	3.06
June	3.88	4.14	3.50	3.44	3.54	3.29	3.61
July	2.82	2.68		2.33	2.50	2.50	2.93
August	2.56	2.51		2.22	1.91	2.30	3.14
September	2.10	2.32	3.85	2.26	1.94	2.00	2.09
October	2.96	2.92		3.76	3.67	2.36	2.43

Table 36 - Monthly Variation of Ash Content of Pasture Grass from each Plot

Results in percent of water free substance

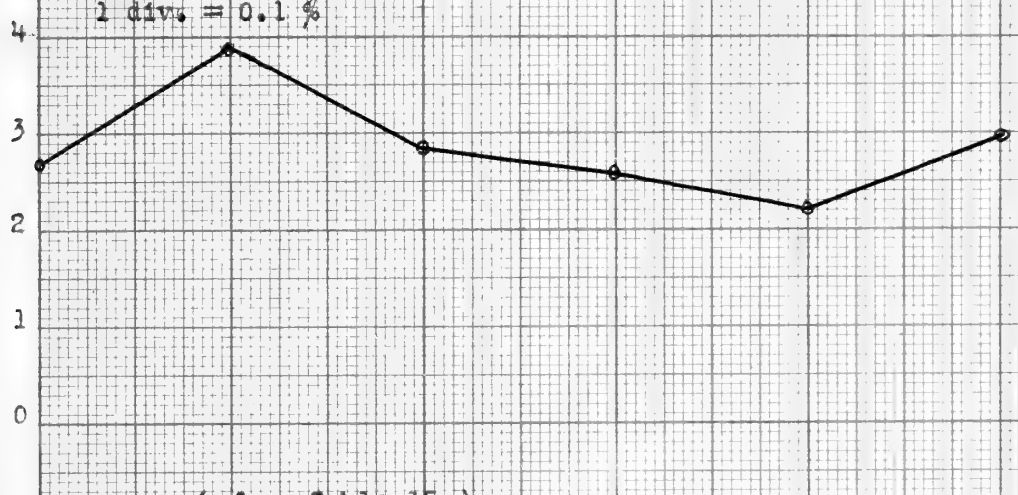
	No treatment			Disced		Disced and manured	
Month	Plot 1 cut weekly	Plot 2 cut biweekly	Plot 7 cut twice a year	Plot 3 cut weekly	Plot 4 cut biweekly	Plot 5 cut weekly	Plot 6 cut bi-weekly
May	9.07	8.69		9.71	8.93	10.57	10.31
June	10.35	10.32	7.50	9.71	9.42	9.98	10.31
July	8.42	8.65		8.06	8.22	8.77	9.01
August	7.62	7.69		7.20	7.17	7.93	8.02
September	6.95	7.02	8.89	7.30	6.24	8.14	8.04
October	8.61	9.18		10.66	10.92	9.03	9.64

CHART XXV.

MONTHLY VARIATION OF THE ASH CONTENT

OF PASTURE GRASS

(fresh basis)



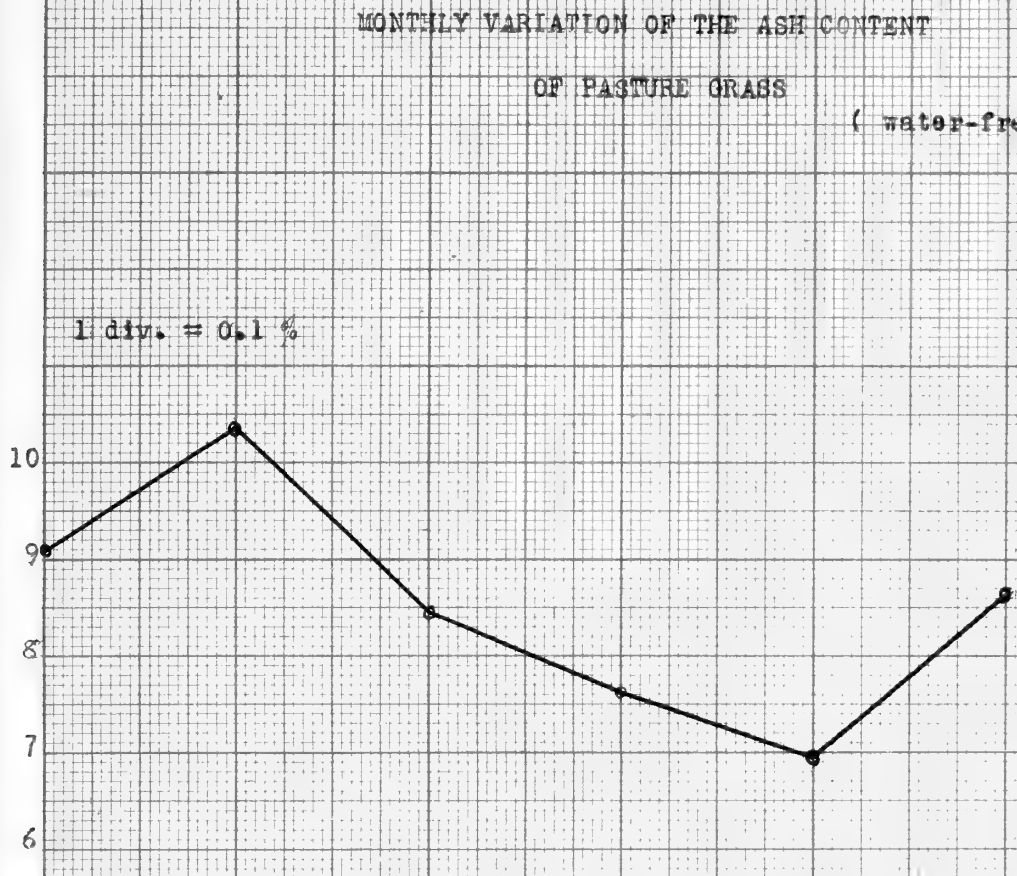
(from Table 35)

CHART XXVI.

MONTHLY VARIATION OF THE ASH CONTENT

OF PASTURE GRASS

(water-free basis)



(from Table 36)

Table 37 - Showing in the First Column the Monthly Variation of the Influence of Tillage upon the Ash Content of Pasture Grass and in the Second Column the same Date for Manure

Results in percent of fresh substance

Month	Increase due to tillage	Increase due to manure
May	+ 0.47	+ 0.24
June	- 0.44	- 0.15
July	- 0.49	+ 0.17
August	- 0.34	+ 0.08
September	+ 0.16	- 0.26
October	+ 0.80	- 1.40

Table 38 - Showing in the First Column the Monthly Variation of the Influence of Tillage upon the Ash Content of Pasture Grass and in the Second Column the same Data for Manure

Results in percent of water free substance

Month	Increase due to tillage	Increase due to manure
May	+ 0.64	+ 0.86
June	- 0.64	+ 0.27
July	- 0.36	+ 0.71
August	- 0.42	+ 0.73
September	+ 0.35	+ 0.84
October	+ 2.05	- 1.63

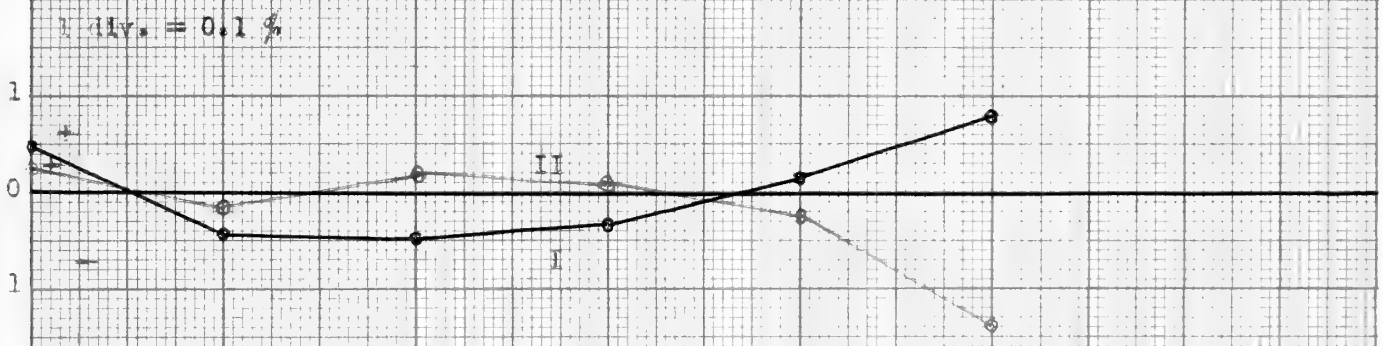
CHART XXVII.

INFLUENCE OF TILLAGE AND MANURE UPON THE ASH CONTENT OF PASTURE GRASS

(fresh basis)

Curve I = increase or decrease due to tillage

Curve II = increase or decrease due to manure



(from Table 37)

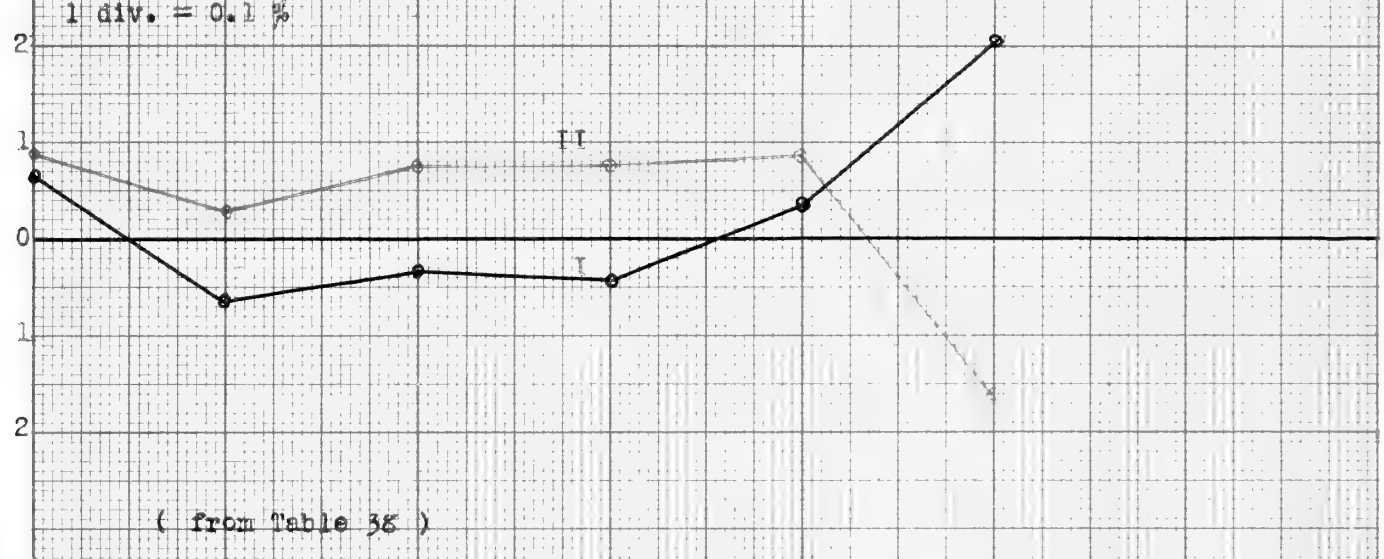
CHART XXVIII.

INFLUENCE OF TILLAGE AND MANURE UPON THE ASH CONTENT OF PASTURE GRASS

(water-free basis)

Curve I = increase or decrease due to tillage

Curve II = increase or decrease due to manure



(from Table 36)

Table 39 - Ash Content of Pasture Grass. Weekly cut Plots Averaged to Compare with Biweekly cut Plots

Results in percent of fresh substance

Date cut	No treatment			Disced		Disced and manured	
	Plot 1 cut weekly	Plot 2 cut biweekly	Plot 7 cut twice a year	Plot 3 cut weekly	Plot 4 cut biweekly	Plot 5 cut weekly	Plot 6 cut bi-weekly
May 10	2.48	2.33		3.22	2.46	2.83	2.82
" 25	2.79	2.84		3.11	2.80	3.68	3.30
June 8	3.45	3.42	3.50	3.30	3.05	3.30	3.11
" 22	4.32	4.86		3.87	4.02	3.57	4.10
July 10	3.39	2.79		2.68	2.33	2.49	3.46
" 20	2.72	2.47		2.34	2.66	2.53	2.39
Aug. 3	2.86	2.69		2.24	2.49	2.56	2.83
" 17	2.96	2.72		2.48	2.21	2.73	2.43
" 31	2.07	2.11		1.91	1.04	1.81	1.02
Sept.14	1.81	1.84	3.85	2.03	1.55	1.88	1.90
" 28	2.40	2.79		2.49	2.32	2.12	2.27
Oct. 13	2.96	2.92		3.76	3.67	2.36	2.43

Table 40 - Ash Content of Pasture Grass. A Comparison of Plots cut Biweekly with Plots cut Weekly

Results in percent of fresh substance

Date	Difference between untreated plots	Difference between disced plots	Difference between disced and manured plots
May 10	- 0.15	- 0.76	- 0.01
" 25	+ 0.05	- 0.31	- 0.38
June 8	- 0.03	- 0.25	- 0.19
" 22	+ 0.54	+ 0.15	+ 0.53
July 10	- 0.60	- 0.35	+ 0.97
" 20	- 0.25	+ 0.32	- 0.14
Aug. 3	- 0.17	+ 0.25	+ 0.27
" 17	- 0.24	- 0.27	- 0.30
" 31	+ 0.04	- 0.87	- 0.79
Sept.14	+ 0.03	- 0.48	+ 0.02
" 28	+ 0.39	- 0.17	+ 0.15
Oct. 13	- 0.04	- 0.09	+ 0.07

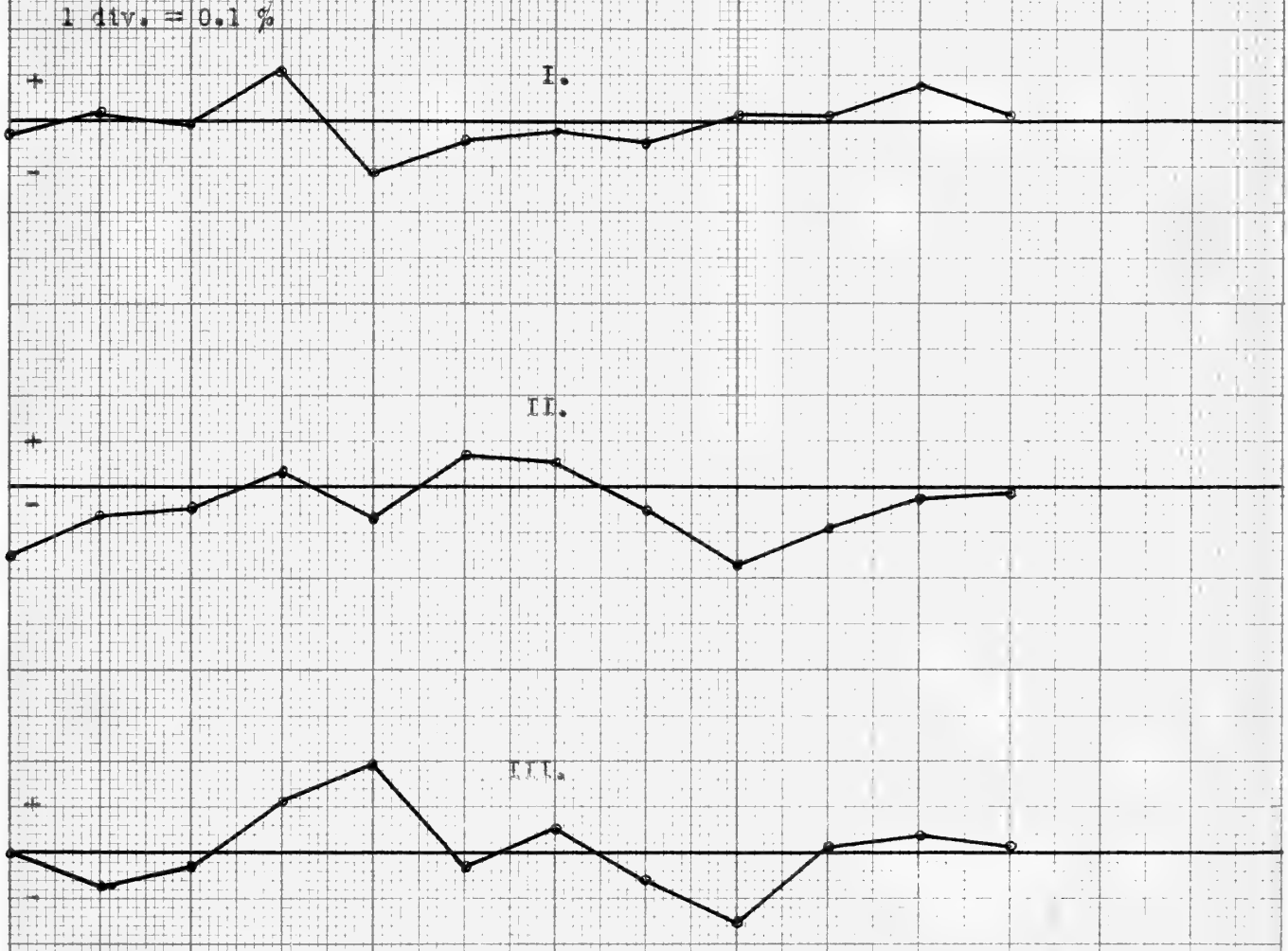
May 10 25 | June 8 22 | July 6 22 | Aug. 3 17 31 | Sept. 14 28 | Oct. 13

CHART XXIX.

INFLUENCE OF FREQUENCY OF CUTTING UPON THE ASH CONTENT OF PASTURE GRASS

(fresh basis)

I - Untreated plot cut biweekly
II - Disced plot cut biweekly
III - Disced , manured plot cut biweekly



(from Table 40)

NO 346

Table 41 - Ash Content of Pasture Grass. Weekly cut Plots Averaged to Compare with Biweekly cut Plots

Results in percent of water free substance

Date cut	No treatment			Disced		Disced and manured	
	Plot 1 cut weekly	Plot 2 cut biweekly	Plot 7 cut twice a year	Plot 3 cut weekly	Plot 4 cut biweekly	Plot 5 cut weekly	Plot 6 cut bi-weekly
May 10	8.77	8.21		9.71	8.92	9.64	9.38
" 25	9.22	9.16		9.72	8.94	11.05	11.24
June 8	10.51	9.91	7.50	10.07	8.72	10.86	10.58
" 22	10.53	10.73		9.82	10.11	9.79	10.04
July 10	9.24	8.66		8.55	8.33	8.51	8.31
" 20	8.31	8.64		7.95	8.23	9.00	8.62
Aug. 3	8.11	8.10		7.81	7.74	8.46	8.59
" 17	7.76	7.64		7.27	6.92	7.72	7.58
" 31	7.32	7.32		6.96	[illegible]	7.97	7.90
Sept.14	6.59	6.12	8.89	7.12	7.47	7.63	7.58
" 28	7.31	7.91		7.49	7.00	8.66	8.49
Oct. 13	8.61	9.18		10.66	10.92	9.03	9.64

Table 42 - Ash Content of Pasture Grass. A Comparison of Plots cut Biweekly with Plots cut Weekly

Results in percent of water free substance

Date	Difference between untreated plots	Difference between disced plots	Difference between disced and manured plots
May 10	- 0.56	- 0.79	- 0.26
" 25	- 0.06	- 0.78	+ 0.19
June 8	- 0.60	- 1.53	- 0.28
" 22	+ 0.20	+ 0.29	+ 0.25
July 10	- 0.58	- 0.22	- 0.20
" 20	+ 0.33	+ 0.28	- 0.38
Aug. 3	- 0.01	- 0.07	+ 0.13
" 17	- 0.12	- 0.35	- 0.14
" 31	None	- 0.10	- 0.07
Sept.14	- 0.47	- 1.65	- 0.05
" 28	+ 0.60	- 0.49	- 0.15
Oct. 13	+ 0.57	+ 0.26	+ 0.61

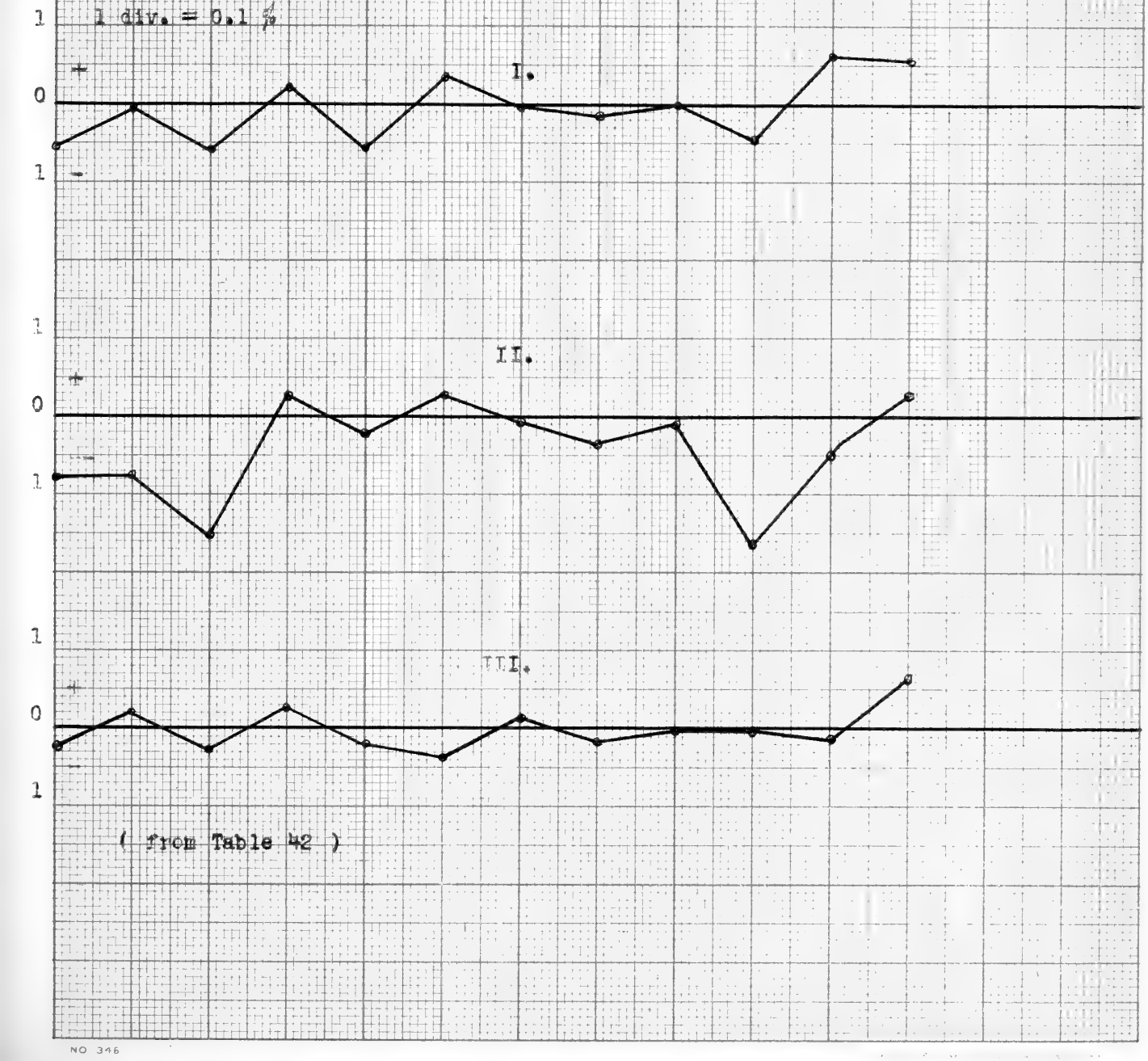
May 10 25 | June 8 22 | July 6 22 | Aug. 3 17 31 | Sept. 14 28 | Oct. 13

CHART XXX.

INFLUENCE OF FREQUENCY OF CUTTING UPON THE ASH CONTENT OF PASTURE GRASS

(water-free basis)

I- Untreated plot cut biweekly
II- Disced plot cut biweekly
III- Disced, manured plot cut biweekly



(from Table 42)

CARBOHYDRATES

The data bearing upon the influence of the age of the pasture season upon the carbohydrate content of pasture grass is found in Table 43, 44, 45, and 46, and Charts XXXI. and XXXII. A study of these data show that the carbohydrate content of the grass does not vary much throughout the season when the grass is kept cropped closely. Upon the fresh basis it appears that the June grass contains the highest percent of carbohydrates, while May grass contains the lowest. The maximum content is 25.71 percent, while the minimum is 21.37 percent. Upon the water free basis, July and October are the months of low carbohydrate content. Upon this basis the fluctuations are somewhat greater.

Influence of Tillage

The influence of tillage upon the carbohydrate content of grass is shown in the first column of Table 47 and 48 and the first curve in Charts XXXIII. and XXXIV. It will be seen from the tables and charts, particularly the charts, that tillage has a tendency to lower the carbohydrate content of pasture grass. This effect is quite uniform, viewed from either the fresh basis or the water free basis. The average decrease of this constituent for the season due to this difference is over one percent.

Influence of Manure

The data upon this point is found in the second column of Table 47 and 48, and the second curve in Charts XXXIII. and XXXIV. The influence of manure is similar to that produced by discing the soil. It is more pro-

nounced, however. It will be noted, in the study of the data, that as the pasture season becomes more advanced the carbohydrate decrease becomes larger. On the fresh basis a decrease of from 1 to 6 percent is recorded.

Influence of Frequent Cutting

The data for the influence of frequency of cutting upon the carbohydrate content of pasture grass is found in Tables 49, 50, 51, and 52 and Charts XXXV. and XXXVI. The effect of this influence is to increase the carbohydrate content. This, as may be expected, applies with equal force to the check plot. Some exceptions can be noted but the weight of evidence goes to show that biweekly cutting of grass as compared with weekly cut grass increases the carbohydrate content. In case of the grass cut twice a year, a large increase of about 12 percent is noted.

Table 43 - Carbohydrate Content of Pasture Grass for each Cutting from each Plot

Results in percent of fresh substance

Date cut	No treatment			Disced		Disced and manured	
	Plot 1 Cut weekly	Plot 2 Cut biweekly	Plot 7 Cut twice a year	Plot 3 Cut weekly	Plot 4 Cut biweekly	Plot 5 Cut weekly	Plot 6 Cut bi-weekly
May 10	20.43	20.78		23.39	19.83	20.68	21.20
" 18	21.87	--		23.09	--	24.41	--
" 25	21.81	22.13		21.78	22.23	19.15	18.67
June 1	21.89	--		21.19	--	18.83	--
" 8	24.17	24.28	37.87	23.51	24.84	19.81	19.12
" 15	24.68	--		22.16	--	18.50	--
" 22	31.11	31.11		31.45	27.16	28.38	26.70
" 29	26.72	--		22.25	--	20.48	--
July 6	21.67	21.50		19.50	18.80	16.75	27.12
" 13	22.17	--		18.80	--	16.48	--
" 20	21.85	18.88		20.97	21.94	18.47	18.05
" 27	24.06	--		18.49	--	20.08	--
Aug. 3	23.53	22.46		20.96	22.32	19.10	21.71
" 10	28.38	--		22.55	--	23.06	--
" 17	23.72	25.23		25.06	23.30	23.74	21.92
" 24	20.56	--		18.42	--	15.70	--
" 31	18.06	20.19		19.54	10.91	13.04	8.51
Sept. 8	17.54	--	31.10	17.12	--	14.42	--
" 14	21.37	22.80		20.63	22.57	19.97	17.03
" 21	24.48	--		24.59	--	15.62	--
" 28	20.97	24.26		22.40	23.37	14.08	16.70
Oct. 7	22.68	--		22.57	--	14.62	--
" 13	21.17	20.63		21.89	21.63	15.21	14.95

Table 44 - Carbohydrate Content of Pasture Grass for each Cutting from each Plot

Results in percent of water free substance

Date cut	No treatment			Disced		Disced and manured	
	Plot 1 Cut weekly	Plot 2 Cut biweekly	Plot 7 Cut twice a year	Plot 3 Cut weekly	Plot 4 Cut biweekly	Plot 5 Cut weekly	Plot 6 Cut biweekly
May 10	72.44	73.06		70.56	71.83	70.39	70.60
" 18	72.98	--		71.19	--	67.19	--
" 25	71.53	71.30		69.18	70.86	63.32	63.70
June 1	69.48	--		67.56	--	62.57	--
" 8	70.44	70.29	81.19	68.56	71.14	64.61	65.07
" 15	69.04	--		67.61	--	62.80	--
" 22	67.96	68.74		68.14	68.37	65.13	65.37
" 29	66.83	--		68.24	--	64.78	--
July 6	65.50	66.63		65.18	67.16	62.71	65.12
" 13	67.19	--		67.39	--	64.21	--
" 20	67.29	66.03		67.69	67.89	61.11	65.14
" 27	67.46	--		68.93	--	64.69	--
Aug. 3	67.73	67.72		68.21	69.48	64.70	65.82
" 10	67.73	--		68.68	--	65.47	--
" 17	69.82	70.86		71.02	72.79	66.94	68.47
" 24	67.34	--		68.50	--	63.19	--
" 31	69.32	70.17		69.96	71.80	63.03	66.10
Sept. 8	73.18	--	71.82	74.93	--	65.73	--
" 14	70.15	75.64		63.21	79.35	72.19	67.82
" 21	71.53	--		73.59	--	61.65	--
" 28	66.65	68.71		67.74	70.61	59.27	62.61
Oct. 7	63.73	--		64.46	--	56.95	--
" 13	63.75	64.93		61.69	64.41	57.13	59.30

Table 45 - Monthly Variation of Carbohydrate Content of Pasture Grass from each Plot

Results in percent of fresh substance

	No treatment			Disced		Disced and manured	
Month	Plot 1 cut weekly	Plot 2 cut biweekly	Plot 7 cut twice a year	Plot 3 cut weekly	Plot 4 cut biweekly	Plot 5 cut weekly	Plot 6 cut bi-weekly
May	21.37	21.46		22.75	20.96	21.41	19.94
June	25.71	27.70	37.87	24.11	26.00	21.20	22.91
July	22.44	20.19		18.44	20.37	17.95	22.59
August	22.85	22.63		21.31	18.84	18.93	17.38
September	22.09	23.53	31.10	21.19	23.47	16.02	16.87
October	21.93	20.63		22.23	21.63	14.92	14.95

Table 46 - Monthly Variation of Carbohydrate Content of Pasture Grass from each Plot

Results in percent of water free substance

	No treatment			Disced		Disced and manured	
Month	Plot 1 cut weekly	Plot 2 cut biweekly	Plot 7 cut twice a year	Plot 3 cut weekly	Plot 4 cut biweekly	Plot 5 cut weekly	Plot 6 cut bi-weekly
May	72.32	72.18		70.31	71.35	66.97	67.15
June	68.75	69.52	81.19	68.02	69.76	63.98	65.22
July	66.86	66.33		67.27	67.53	63.18	65.13
August	68.39	69.58		69.25	71.36	64.67	66.46
September	70.38	72.18	71.82	69.87	74.97	64.71	65.22
October	63.74	64.93		63.08	64.41	57.04	59.30

May June July Aug. Sept. Oct.

CHART XXXI.

MONTHLY VARIATION OF THE CARBOHYDRATE CONTENT OF PASTURE GRASS

(fresh basis)

1 div. = 0.1 %

(from Table 45)

May June July Aug. Sept. Oct.

CHART XXXII.

MONTHLY VARIATION OF THE CARBOHYDRATE CONTENT OF PASTURE GRASS

(water-free basis)

1 div. = 0.1 %

(from Table 46)

NO 346

Table 47 - Showing in the First Column the Monthly Variation of the Influence of Tillage upon the Carbohydrate Content of Pasture Grass, and in the Second Column the same data for Manure

Results in percent of fresh substance

Month	Increase due to tillage	Increase due to manure
May	+ 1.38	- 1.34
June	- 1.60	- 2.91
July	- 4.00	- 2.89
August	- 1.54	- 2.38
September	- 0.90	- 5.17
October	- 0.98	- 6.03

Table 48 - Showing in the First Column the Monthly Variation of the Influence of Tillage upon the Carbohydrate Content of Pasture Grass, and in the Second Column the same Data for Manure

Results in percent of water free substance

Month	Increase due to tillage	Increase due to manure
May	- 2.01	- 3.32
June	- 0.73	- 4.04
July	+ 0.41	- 4.09
August	+ 0.86	- 4.58
September	- 0.51	- 5.16
October	- 0.66	- 6.04

May June July Aug. Sept. Oct.

CHART XXXIII

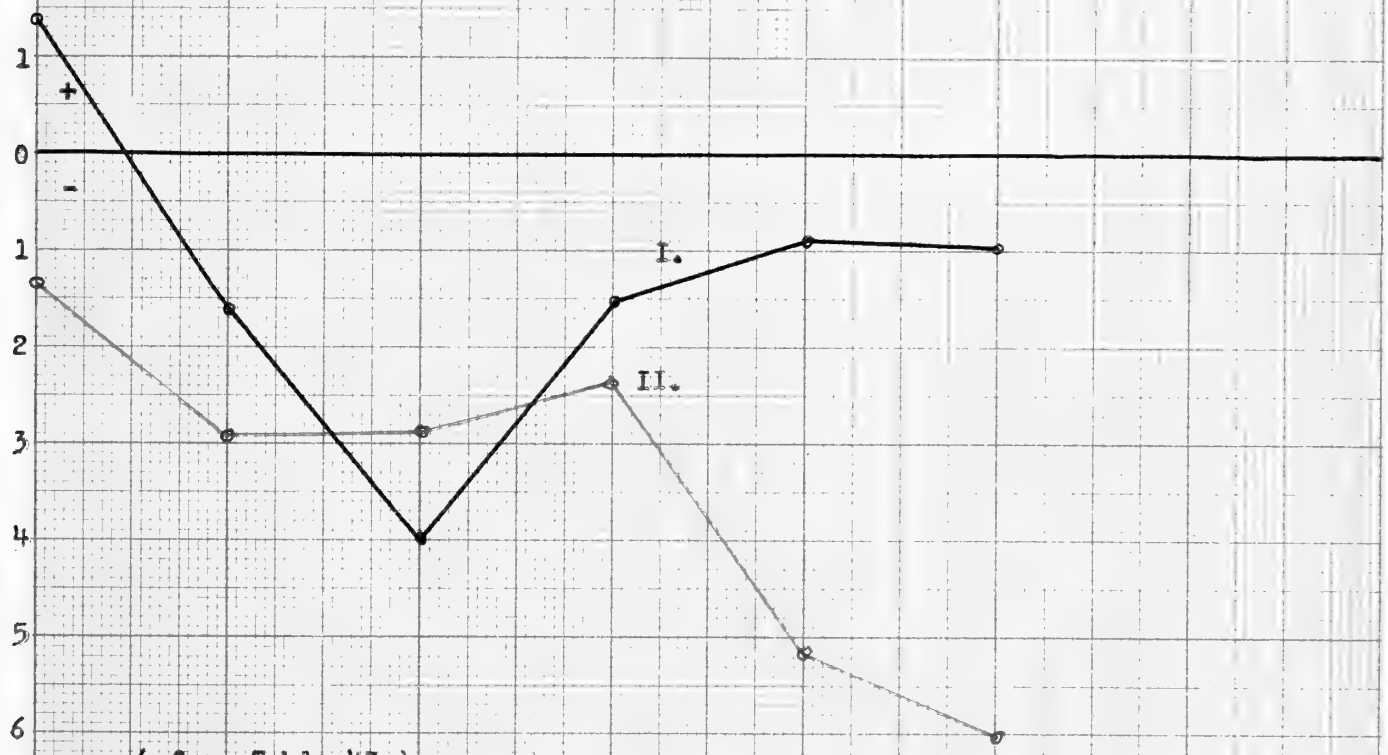
INFLUENCE OF TILLAGE AND MANURE UPON THE CARBOHYDRATE CONTENT OF PASTURE GRASS

(fresh basis)

Curve I = increase or decrease due to tillage

Curve II = increase or decrease due to manure

1 div. = 0.1 %



(from Table 47)

NO 346

May June July Aug. Sept. Oct.

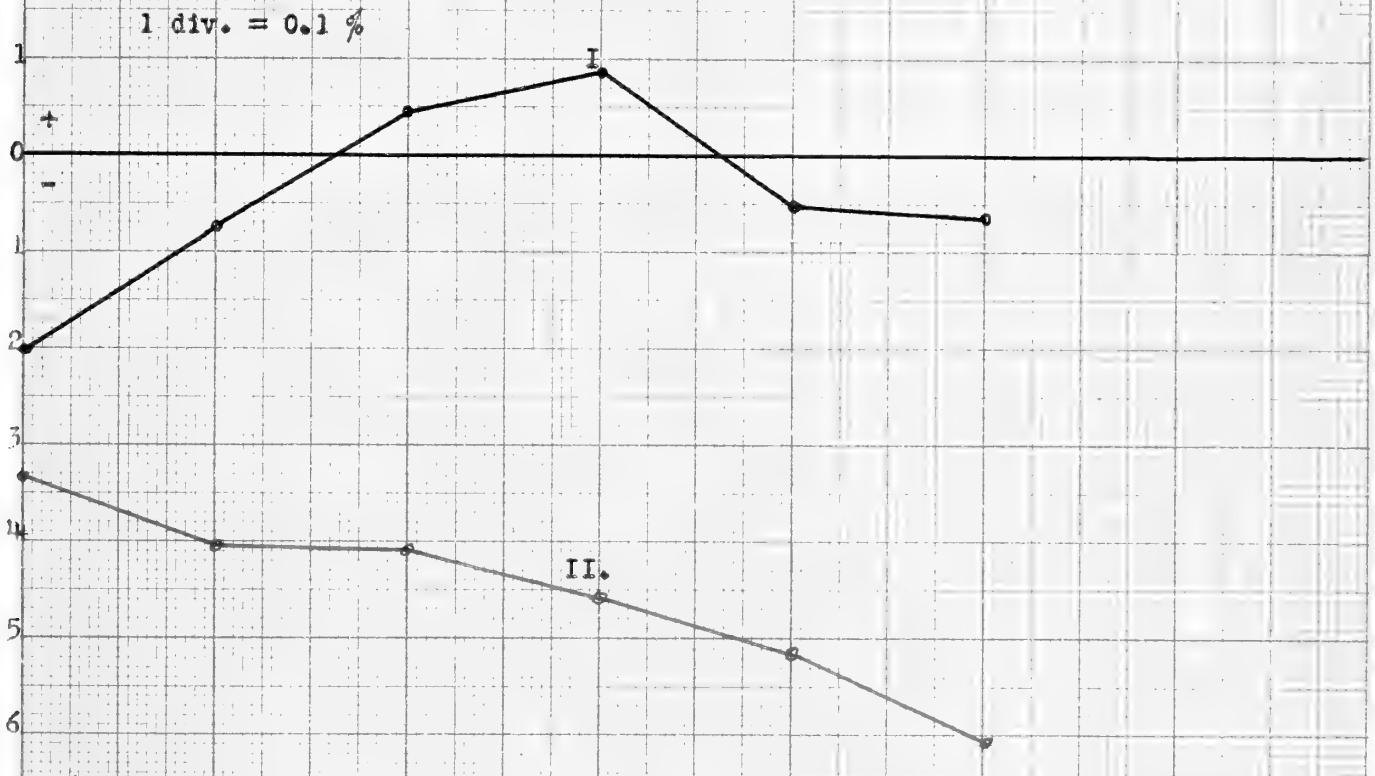
CHART XXXIV

INFLUENCE OF TILLAGE AND MANURE UPON THE CARBOHYDRATE CONTENT OF PASTURE GRASS

(water-free basis)

Curve I = increase or decrease due to tillage

Curve II = increase or decrease due to manure



(from Table 48)

NO 346

Table 49 - Carbohydrate Content of Pasture Grass. Weekly cut Plots averaged to compare with Biweekly cut Plots

Results in percent of fresh substance

Date cut	Plot 1 cut weekly	Plot 2 cut biweekly	Plot 7 cut twice a year	Plot 3 cut weekly	Plot 4 cut biweekly	Plot 5 cut weekly	Plot 6 cut bi-weekly
May 10	20.43	20.78		23.39	19.83	20.68	21.20
" 25	21.84	22.13		22.44	22.23	21.78	18.67
June 8	23.03	24.28	37.87	22.35	24.84	19.32	19.12
" 22	27.90	31.11		26.81	27.16	23.44	26.70
July 6	24.20	21.50		20.88	18.80	18.62	26.12
" 20	22.01	18.88		19.89	21.94	17.48	18.05
August 3	23.80	22.46		19.73	22.32	19.59	21.71
" 17	26.05	25.23		23.81	23.30	19.72	21.92
" 31	19.28	20.19		18.98	10.91	14.37	8.51
Sept. 14	19.46	22.80	31.10	18.88	22.57	17.19	17.03
" 28	22.73	24.26		23.40	23.37	14.85	16.70
Oct. 13	21.93	20.63		22.23	21.63	14.92	14.95

Table 50 - Carbohydrate Content of Pasture Grass. A Comparison of Plots cut Biweekly with Plots cut Weekly

Results in percent of fresh substance

Date	Difference between untreated plots	Difference between disced plots	Difference between disced and manured plots
May 10	+ 0.35	- 3.56	+ 0.52
" 25	+ 0.29	- 0.21	- 3.11
June 8	+ 1.25	+ 2.49	- 0.20
" 22	+ 3.21	- 0.35	+ 3.26
July 6	- 2.70	- 2.08	+ 8.50
" 20	- 3.13	+ 2.05	+ 0.57
Aug. 3	- 1.34	+ 2.59	+ 2.12
" 17	- 0.82	- 0.51	+ 2.20
" 31	+ 0.91	- 8.07	- 5.86
Sept.14	+ 3.34	+ 3.69	- 0.16
" 28	+ 1.53	- 0.03	+ 1.85
Oct. 13	- 1.30	- 0.60	+ 0.03

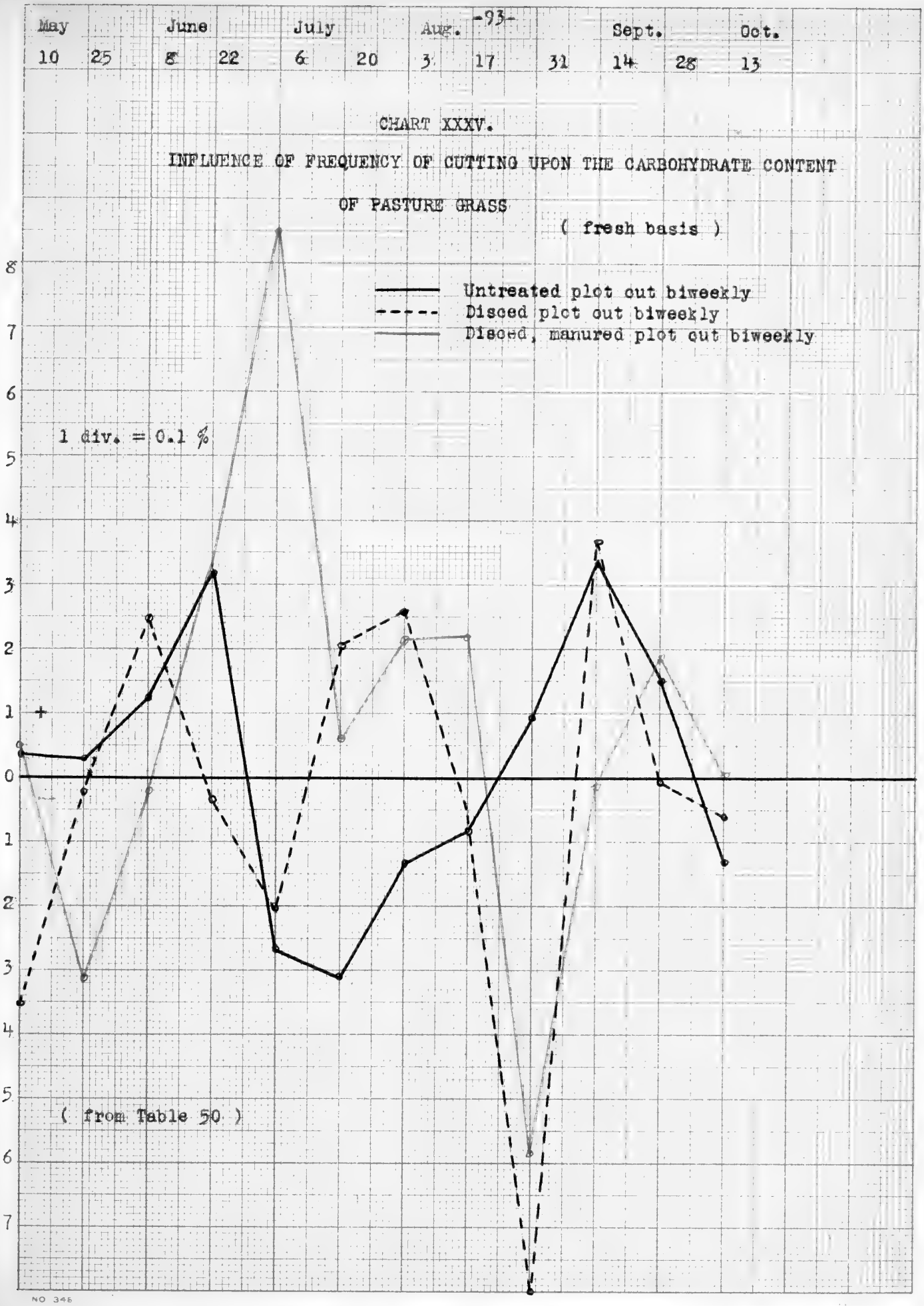


CHART XXXV.

INFLUENCE OF FREQUENCY OF CUTTING UPON THE CARBOHYDRATE CONTENT OF PASTURE GRASS

(fresh basis)

Untreated plot cut biweekly
Disced plot cut biweekly
Disced, manured plot cut biweekly

1 div. = 0.1 %

(from Table 50)

NO 346

Table 51 - Carbohydrate Content of Pasture Grass. Weekly cut Plots averaged to compare with Biweekly cut Plots

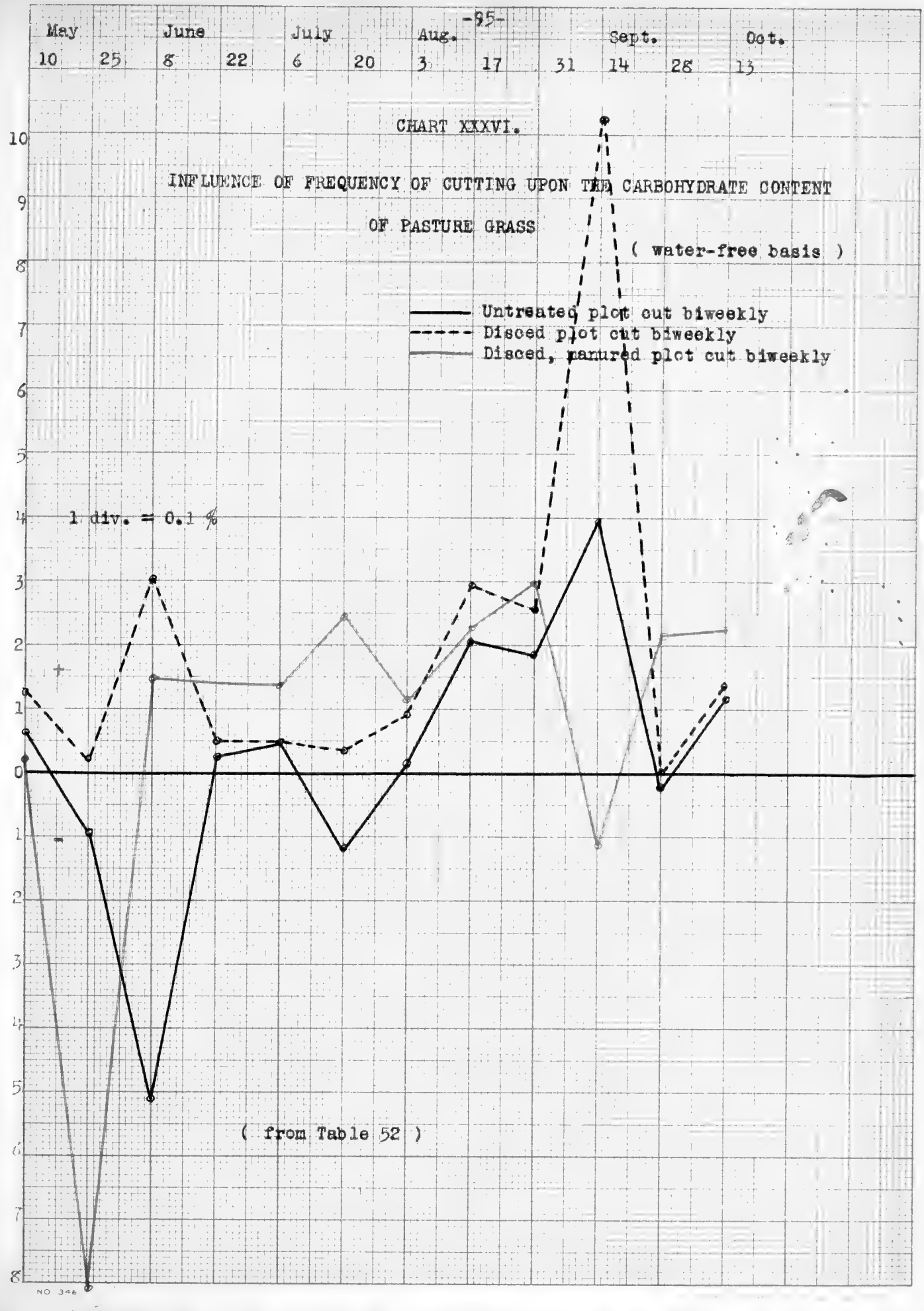
Results in percent of water free substance

Date cut	No treatment			Disced		Disced and manured	
	Plot 1 cut weekly	Plot 2 cut biweekly	Plot 7 cut twice a year	Plot 3 cut weekly	Plot 4 cut biweekly	Plot 5 cut weekly	Plot 6 cut bi-weekly
May 10	72.44	73.06		70.56	71.83	70.39	70.60
" 25	72.26	71.30		70.68	70.86	75.26	63.70
June 8	75.46	70.29	81.19	68.06	71.14	63.59	65.07
" 22	68.50	68.74		67.88	68.37	63.97	65.37
July 6	66.17	66.63		66.71	67.16	63.75	65.12
" 20	67.24	66.03		67.54	67.89	62.66	65.14
Aug. 3	67.60	67.72		68.57	69.48	64.70	65.82
" 17	68.78	70.86		69.85	72.79	66.21	68.47
" 31	68.33	70.17		69.23	71.80	63.11	66.10
Sept.14	71.67	75.64	71.82	69.07	79.35	68.96	67.82
" 28	69.09	68.71		70.67	70.61	60.46	62.61
Oct. 13	63.74	64.93		63.08	64.41	57.04	59.30

Table 52 - Carbohydrate Content of Pasture Grass. A Comparison of Plots cut Biweekly with Plots cut Weekly

Results in percent of water free substance

Date	Difference between untreated plots	Difference between disced plots	Difference between disced and manured plots
May 10	+ 0.62	+ 1.27	+ 0.21
" 25	- 0.96	+ 0.18	-11.56
June 8	- 5.17	+ 3.08	+ 1.48
" 22	+ 0.24	+ 0.49	+ 1.40
July 10	+ 0.46	+ 0.45	+ 1.37
" 20	- 1.21	+ 0.35	+ 2.48
Aug. 3	+ 0.12	+ 0.91	+ 1.12
" 17	+ 2.08	+ 2.94	+ 2.26
" 31	+ 1.84	+ 2.57	+ 2.99
Sept.14	+ 3.97	+10.28	- 1.14
" 28	- 0.28	- 0.06	+ 2.15
Oct. 13	+ 1.19	+ 1.33	+ 2.26


May
10
25
June
8
22
July
6
20
Aug.
3
17
31
Sept.
14
28
Oct.
13
CHART XXXVI.
INFLUENCE OF FREQUENCY OF CUTTING UPON THE CARBOHYDRATE CONTENT
OF PASTURE GRASS
(water-free basis)
Untreated plot cut biweekly
Disced plot cut biweekly
Disced, manured plot cut biweekly
1 div. = 0.1 %
(from Table 52)

Nutritive Ratio

The value of a feed is measured by its nutritive ratio; that is, the relation between its digestible protein and its digestible carbohydrates, and fats or ether extract. In order to obtain the nutritive ratio and study the value of pasture grass as a feed, tables were prepared expressing the composition of the grass in terms of digestible nutrients. As no digestion experiments were made upon the grass, it was necessary to use coefficients of digestion obtained from other sources.(9) The following coefficients were used in the calculation of the digestible nutrients of pasture grass in this study.

Protein was regarded as 70 percent digestible, ether extract, as 63 percent, and the carbohydrates, as 73.8 percent digestible. The entire data bearing upon the nutritive ratio of pasture grass is shown in Tables 53 to 62 inclusive and in Charts XXXVII., XXXVIII., XXXIX., and XL.

Influence of Age of Pasture Season

The data upon the influence of the age of the pasture season upon the nutritive ratio of pasture grass is found in Table 60 and Chart XXXVII. An inspection of these results show that the ratio is widest in May and September, while it is narrowest in July and October. The ratio ranges from 1: 3.4 to 1: 5.6.

Influence of Tillage

The data upon the influence of tillage upon the nutritive ratio of pasture grass is found in Table 61 and Chart XXXVIII. It is apparent from

this table and chart that tillage narrows the ratio,especially the first half of the pasture season. During the latter half of the season the effect is uncertain. In August and October no effect is produced, while the grass for September shows a wider ratio by .7 than the grass from the check plot. The change toward a narrower ratio ranges from 0.2 to 0.5.

Influence of Manure

The data for the effect of manure upon the nutritive ratio of pasture grass is found in Table 60 and Chart XXXVIII. It will be seen here that manuring narrows the ratio from 0.7 to 2.3 points. This effect is most pronounced the latter half of the pasture season. The greatest change toward a narrower ratio is in September, when the ratio of the grass grown under the influence of manure becomes narrower by 2.3 points than the grass from the check plot.

Influence of Frequency of Cutting

The results showing the influence of frequency of cutting upon the nutritive ratio of pasture grass, are found in Table 62 and Chart XXXIX. These data indicate that cutting grass biweekly as compared to cutting it weekly tends to widen the nutritive ratio. This is true of all the plots. In the case of the grass cut twice a year, this result is very evident. The ratio of this grass is nearly twice as wide as that of the grass cut weekly from the check plot. Chart XL. shows this point clearly.

Table 53 - Monthly Variation in Nutrients of Pasture Grass from Plot 1.

Results in percent of fresh substance

	Nutrients			Digestible nutrients		
Month	Protein	Fther extract	Carbo-hydrates	Protein	Ether extract	Carbo-hydrates
May	4.43	1.07	21.37	3.10	0.67	15.77
June	6.21	1.66	25.71	4.35	1.05	18.97
July	6.51	1.53	22.44	4.56	0.96	16.56
August	6.13	1.90	22.85	4.29	1.20	16.86
September	5.42	1.87	22.09	3.79	1.18	16.30
October	7.74	1.78	21.93	5.42	1.12	16.18

Table 54 - Monthly Variation in Nutrients of Pasture Grass from Plot 2.

Results in percent of fresh substance

	Nutrients			Digestible nutrients		
Month	Protein	Ether extract	Carbo-hydrated	Protein	Ether extract	Carbo-hydrates
May	4.58	1.13	21.96	3.21	0.71	16.21
June	6.34	1.73	27.70	4.44	1.09	20.44
July	5.83	1.74	20.19	4.08	1.10	14.90
August	5.52	1.86	22.63	3.86	1.17	16.70
September	5.60	1.38	23.53	3.92	0.87	17.37
October	6.61	1.62	20.63	4.63	1.02	15.22

Table 55 - Monthly Variation in Nutrients of Pasture Grass from Plot 3

Results in percent of fresh substance

Month	Nutrients			Digestible nutrients		
	Protein	Ether extract	Carbo-hydrates	Protein	Ether extract	Carbo-hydrates
May	5.39	1.07	22.75	3.77	0.67	16.79
June	6.43	1.46	24.11	4.50	0.92	17.79
July	5.71	1.42	18.44	4.00	0.90	13.61
August	5.57	1.64	21.31	3.90	1.03	15.73
September	5.81	1.64	21.19	4.07	1.03	15.64
October	7.72	1.53	22.23	5.40	0.96	16.40

Table 56 - Monthly Variation in Nutrients of Pasture Grass from Plot 4.

Results in percent of fresh substance

Month	Nutrients			Digestible nutrients		
	Protein	Ether extract	Carbo-hydrates	Protein	Ether extract	Carbo-hydrates
May	4.72	1.11	21.03	3.30	0.70	15.52
June	6.23	1.57	26.00	4.36	0.99	19.19
July	5.69	1.60	20.37	3.98	1.01	15.03
August	4.13	1.52	22.81	2.89	0.96	16.83
September	4.65	1.22	16.74	3.26	0.77	12.35
October	6.69	1.60	22.50	4.68	1.01	16.60

Table 57 - Monthly Variation in Nutrients of Pasture Grass from Plot 5.

Results in percent of fresh substance

	Nutrients			Digestible nutrients		
Month	Protein	Ether extract	Carbo-hydrates	Protein	Ether extract	Carbo-hydrates
May	6.09	1.08	21.41	4.26	0.68	15.80
June	7.20	2.04	21.20	5.04	1.29	15.64
July	6.68	1.28	17.95	4.68	0.81	13.25
August	6.50	1.41	18.93	4.55	0.89	13.97
September	5.61	1.03	16.02	3.93	0.65	11.82
October	7.45	1.42	14.92	5.22	0.89	11.01

Table 58 - Monthly Variation in Nutrients of Pasture Grass from Plot 6

Results in percent of fresh substance

	Nutrients			Digestible nutrients		
Month	Protein	Ether extract	Carbo-hydrates	Protein	Ether extract	Carbo-hydrates
May	5.62	1.06	19.94	3.93	0.67	14.72
June	6.98	1.62	22.91	4.98	1.02	16.91
July	7.41	1.77	22.59	5.19	1.12	16.67
August	5.03	1.46	17.38	3.52	0.92	12.83
September	5.81	1.19	16.87	4.07	0.75	12.45
October	6.61	1.22	14.95	4.63	0.77	11.03

Table 59 - Variation in Nutrients of Pasture Grass from Plot 7.

Results in percent of fresh substance

Date cut	Nutrients			Digestible nutrients		
	Protein	Ether extract	Carbo-hydrates	Protein	Ether extract	Carbo-hydrates
June	4.13	1.14	37.87	2.89	0.71	27.95
September	5.66	2.69	31.10	3.96	1.69	22.95

Table 60 - Monthly Variation in Nutritive Ratio of Pasture Grass

Month	No treatment			Disced		Disced and manured	
	Plot 1 cut weekly	Plot 2 cut biweekly	Plot 7 cut twice a year	Plot 3 cut weekly	Plot 4 cut biweekly	Plot 5 cut weekly	Plot 6 cut bi-weekly
May	1: 5.6	1: 5.5		1: 4.9	1: 5.2	1: 4.1	1: 4.1
June	1: 4.9	1: 5.0	1:10.2	1: 4.4	1: 4.9	1: 3.6	1: 3.9
July	1: 4.1	1: 4.3		1: 3.9	1: 4.3	1: 3.2	1: 3.7
August	1: 4.6	1: 5.0		1: 4.6	1: 6.5	1: 3.5	1: 4.2
September	1: 5.0	1: 4.9	1:6.8	1: 5.7	1: 4.3	1: 3.4	1: 3.5
October	1:3.4	1: 3.8		1: 3.4	1: 4.0	1: 2.5	1: 2.8

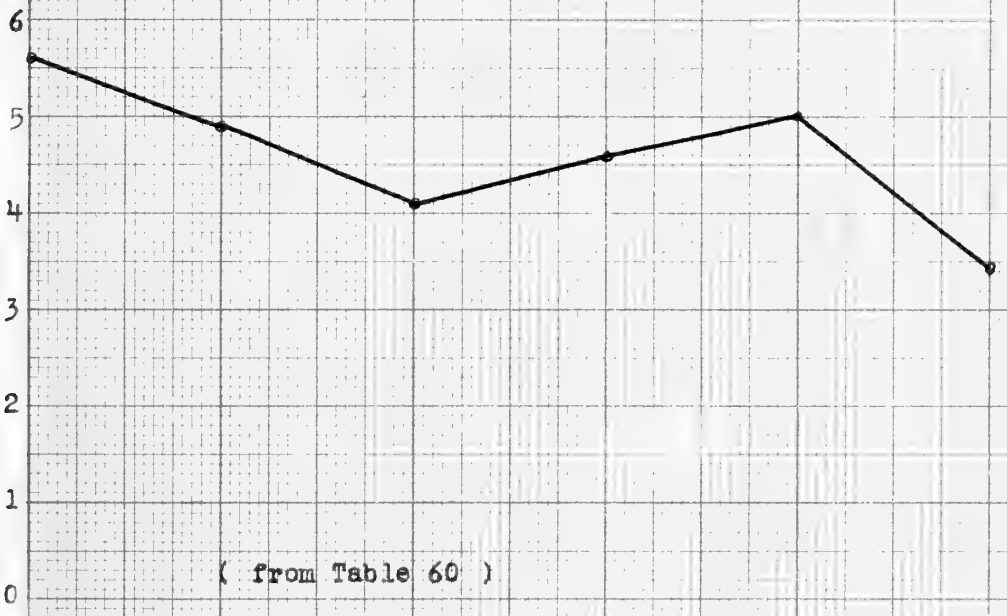
May June July Aug. Sept. Oct.

CHART XXXVII.

MONTHLY VARIATION IN THE NUTRITIVE RATIO

OF PASTURE GRASS

1 div = 0.1



(from Table 60)

NO 346

Table 61 - Showing in the first Column the Monthly variation in the Influence of Tillage upon the Nutritive Ratio of Pasture Grass and in the Second Column the same Data for Manure

Month	Narrowing of ratio due to tillage	Narrowing of ratio due to Manure
May	- 0.5.	- 0.8
June	- 0.5	- 0.8
July	- 0.2	- 0.7
August	None	- 1.1
September	0.7	- 2.3
October	None	- 0.9

\- = Narrower ratio than grass from check plot.
\+ = Wider " " " " " "

Table 62 - Nutritive Ratio of Pasture Grass. A Comparison of Plots cut Biweekly with Plots cut Weekly

Month	Difference between untreated plots	Difference between disced plots	Difference between disced and manured plots
May	- 0.1	+ 0.3	None
June	+ 0.1	+ 0.5	+ 0.3
July	+ 0.2	+ 0.4	+ 0.5
August	+ 0.4	+ 1.9	+ 0.7
September	- 0.1	- 1.2	+ 0.1
October	+ 0.4	+ 0.6	+ 0.3

\- = Narrower ratio due to cutting grass biweekly.
\+ = Wider " " " " " "

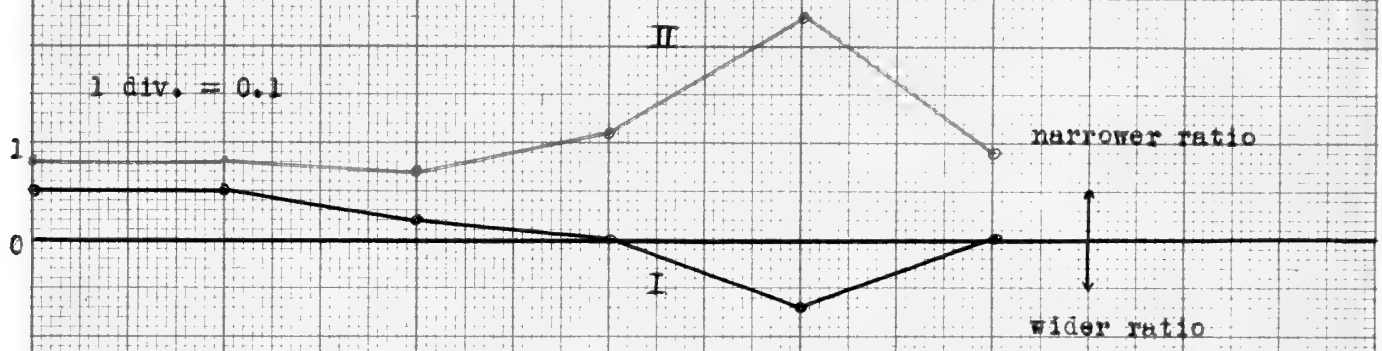
May June July Aug. Sept. Oct.

CHART XXXVIII.

INFLUENCE OF TILLAGE AND MANURE UPON THE NUTRITIVE RATIO OF PASTURE GRASS

Curve I = influence of tillage

Curve II = influence of manure



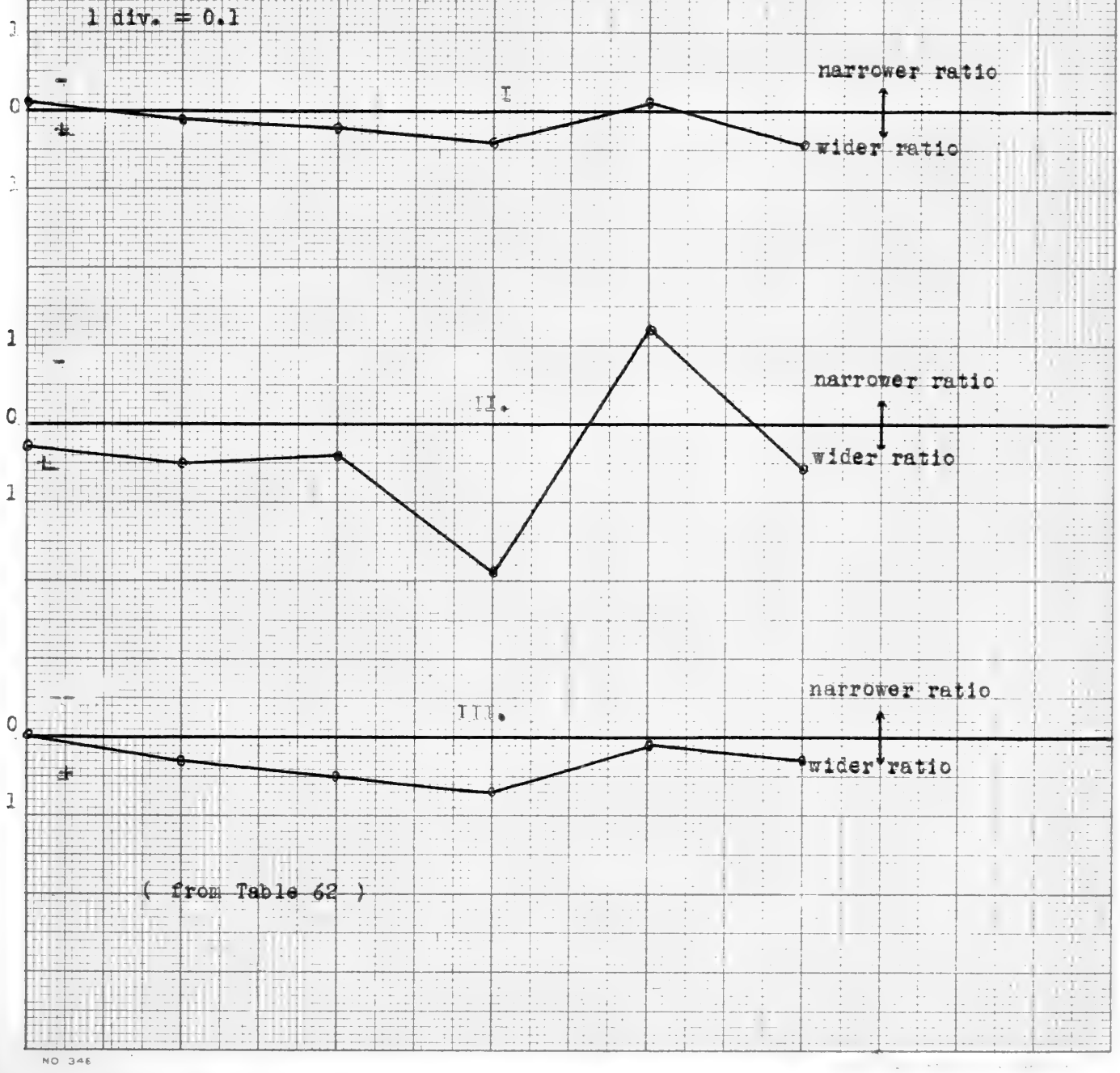
(from Table 61)

May June July Aug. Sept. Oct.

CHART XXXIX.

INFLUENCE OF FREQUENCY OF CUTTING UPON THE NUTRITIVE RATIO OF PASTURE GRASS

I - Untreated plot cut biweekly
II - Disced plot cut biweekly
III - Disced, manured plot cut biweekly



(from Table 62)

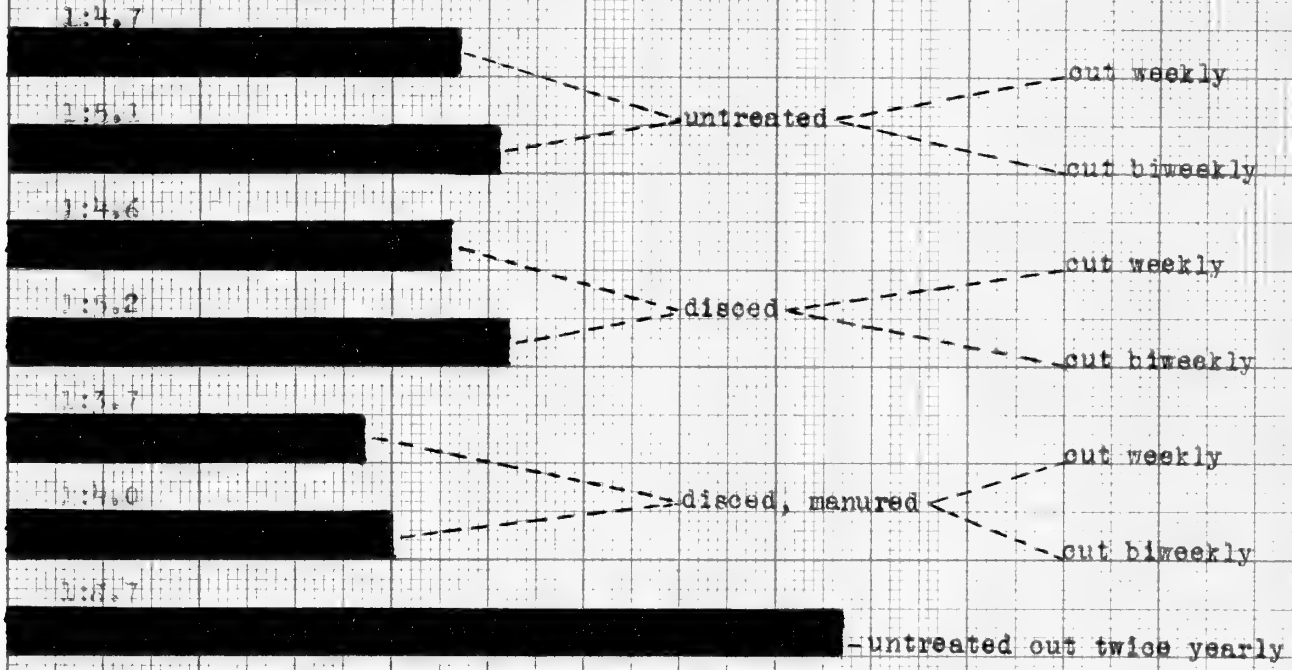
NO 346

CHART XI.

NUTRITIVE RATIO OF PASTURE GRASS

Yearly average for each plot for the season of 1910

1 div. = 0.1



CONCLUSION

While the results of this experiment as presented in this thesis are limited to one pasture season and therefore cannot have the significance that they otherwise would have if based upon several seasons work, these observations in many instances are suggestive and will be corroborated no doubt by the results of succeeding seasons. A summary of the results follows:

The age of the pasture season influences the yield and composition of pasture grass as follows:

1. The best yields are obtained in May and September.

2. The dry matter of the grass is lowest in May and highest in June. It ranges from 29.57 to 39.33 percent, with an average between 32 and 33 percent.

3. The protein is lowest in May and highest in October. It increases from 4.43 percent in May to 6.51 percent in midseason, when it drops to 5.42 percent in September. In October it reaches its maximum of 7.74 percent.

4. The ether extract in grass ranges from 1.07 to 1.90 percent (for May and August.) It increases with the age of the pasture season up to August, when a decline follows.

5. The ash is highest in June and September (3.88 and 2.10 respectively) This constituent declines steadily from June to September. It rises somewhat in October.

6. The extremes for the carbohydrates are 21.37 and 25.71 percent for May and June. From June to July it drops 3 percent and the remainder of the season a further drop of 1 percent is noted.

7. The nutritive ratio is widest in May and September (1: 5.6 and 1: 5.0 respectively), and narrowest in July and October (1: 4.1 and 1: 3.4) It appears that the more abundant the yield the wider the nutritive ratio.

The Influence of Tillage

1. Discing increases the yield from 8.7 to 42.1 percent. This increase is most apparent during the last half of the season.

2. The dry matter in the grass is decreased from 2 to 4.5 percent; that is, the grass is rendered more succulent. This effect is most apparent in the July grass.

3. The protein is increased for May, June and September, 0.32 to 0.96 percent, and decreased for July, August and October, 0.02 to 0.81 percent.

4. The ether extract is decreased from 0.11 to 0.26 percent. The largest losses are in October and August.

5. The ash is also decreased in parts of the season. In middle season losses are from 0.34 to 0.49 percent.It is increased, however, at the beginning and end of the season from 0.47 to 0.80 percent.

6. The carbohydrates are decreased from 0.9 to 4.00 percent, the maximum loss coming in July. May, however, shows an increase of 1.38 percent.

7. For the first half of the season, it appears that the nutritive ratio is narrowed about 0.5 ~~percent~~ . For the last half it will be noted that no effect is apparent in August and October, while the ratio is 0.7 ~~percent~~ wider for September.

The Influence of Manure

1. Manure increases the yield from 185.8 to 486.7 percent. The largest gains are in May, July and October.

2. The dry matter is decreased by manuring. Smallest decrease in July,(0.49 percent) increasing steadily to end of the season, (6.92 percent for October.) May shows an increase of 2.40 percent,with June a decrease of 2.36 percent. It will be seen therefore that manuring has a marked effect upon the succulency of the grass.

3. The protein is increased for the first two months from 0.70 to 0.75 percent, and decreased the remainder of the season. On the water free basis however, the protein increases steadily throughout the season. Starting with 2.37 and ending with 6.58 percent.

4. The ether extract is increased the first two months from 0.01 to 0.58 percent and decreased the remainder of the season from 0.11 to 0.61 percent.

5. The ash content of the grass is increased in May, July, August from 0.08 to 0.24 percent and decreased in June, September and October from 0.15 to 1.40 percent.

6. The carbohydrates are decreased from 1.34 to 6.03 percent. The greatest decrease occurs the last two months.

7. The nutritive ratio is narrowed from 0.7 to 2.3 points. This is most apparent in August and September.

Influence of Frequency of Cutting

1. The yield of grass is decreased by frequent cutting. Compared with the biweekly cut plot, the annual loss on the weekly cut plot is 24.10 pounds. Compared with the plot cut twice yearly, the loss is 78.30 pounds.

2. Cutting grass biweekly instead of weekly decreases dry matter in mid-season, for the untreated plot. In case of the disced plot, in the

majority of cuttings, the dry matter is decreased. The dry matter in the disced manured plot is increased, except in the latter part of May and August. The increase varies from 0.1 to 4.49 percent, while the decrease ranges from 0.12 to 12.22 percent. The dry matter for the grass cut twice yearly, is nearly 12 percent more than that cut weekly.

3. The protein content is largest in the grass cut weekly. Cutting biweekly decreases the percent protein 0.35 percent (yearly average) and cutting twice a year, 1.05 percent. The difference is more evident in the grass from the treated plots. The disced plot lost 0.84 percent, while the disced, manured plots lost 0.46 percent.

4. Ether extract decreases the latter part of the season for the untreated plot, in the biweekly cut grass. It increases for the disced plot and the disced, manured plot. An increase in one case of 0.7 percent is noted.

5. Cutting grass biweekly decreases the ash content in the grass from the untreated plot from 0.25 to 0.60 percent. At the beginning and end of the pasture season, it is decreased for the disced plot. This is the case to some extent for the disced, manured plot.

6. The carbohydrate content is increased to some extent by cutting the grass biweekly. By cutting twice a year it is increased about 12 percent.

7. The nutritive ratio is made wider from 0.1 to 0.7 points by cutting biweekly as compared with weekly cutting. By cutting twice a year the ratio is changed from 1: 4.7 for the weekly cut grass to 1: 8.7. The more frequently grass is cut the greater its nutritive value.

References:

1 - Pennsylvania Station Annual Report, 1889, pages 86-101.

2 - Bulletin No.5, Illinois Agricultural Experiment Station.

3 - Bulletin No. 10, Iowa Agricultural Experiment Station. pages 431-437.

4 - (a) Bulletin No. 19, Louisiana Agricultural Experiment Station, page 189.

(b) Bulletin No. 36, Minnesota Agricultural Experiment Station, page 134.

(c) Bulletin No. 40, South Dakota Agricultural Experiment Station, page124.

(d) Bulletin No. 15, North Dakota Agricultural Experiment Station, page 52.

5 - Bulletin No. 280 Cornell Agricultural Experiment Station.

6 - Bulletin No. 101, Pennsylvania Agricultural Experiment Station.

7 - Bulletin No. 107, Revised, page38-39.

Bureau Chemistry, United States Department of Agriculture.

8 - Ibid. Page 7.

9 - Henry's Feeds and Feeding, 10th edition. Page 579.

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